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MODIFIERS OF PATIENTS' EMERGENCY DEPARTMENT CARE-SEEKING BEHAVIOR

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“Besides, interesting things happen along borders – transitions – not in the middle where everything is the same.”

— Neal Stephenson, *Snow Crash*

Modifiers of patients' Emergency Department care-seeking behavior

THESIS FOR DOCTORAL DEGREE (Ph.D.)

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To my family

ABSTRACT

Background

Inflow of patients to the emergency departments (ED) is increasing in many parts of the world, including Sweden. At the same time the number of EDs are decreasing. In addition to this, ED inflow is volatile. To some degree this volatility is explicable with variations over the hour of the day, day of the week and season, but a considerable portion of the ED inflow is yet to be explained in order to be able to predict the coming load on EDs.

Aim

The overall aim of this thesis is to explore different factors modifying ED inflow.

Methods

In four studies, different possible modifiers of ED inflow and modifiers of the patients' decision to seek ED care was explored. In Study I, laypersons ability to triage trauma cases was investigated in a prospective survey study. In Study II – IV, retrospective observational studies were conducted. Studies II and III explored the impact of online health information seeking and the effect of news media reporting on ED inflow, respectively. In study II, a forecasting model was constructed, including website visits as explanatory variable, Study IV assessed the impact of callers' sociodemographic background on advice from a telephone advice service (TAS) and compliance to those advices.

Results

For Study I, 69 persons participated in the study, who in total triaged 52 % of the cases correctly. There was an over-triage (i.e. case triaged as more serious than it was) in 12.5 % and under-triage in 6.3 % of the cases. In Study II, correlation between a population's number of visits to a regional website for health information and physical ED inflow was found. The forecasting model in Study II exhibited Mean Absolute Percentage Error of 4.8 %. In Study III, it was shown that news media reporting negativity, expressed as a numeric index, significantly correlated to and partially explained ED inflow. In Study IV, findings were that both the advices given to a caller by the TAS and the caller's odds of complying to the advice were affected by sociodemographic factors, but that the compliance was also affected by the advice issued.

Conclusions

This thesis shows that ED care-seeking behavior is modified by online health information, news media reporting, advices from the TAS and by the individual's own sociodemographic background. This knowledge can be used to better understand ED care-seeking behavior and to construct better forecasting models of ED inflow.

MeSH terms

emergency services; hospital; health behavior; trauma severity indices; forecasting; mass media; referral and consultation

LIST OF SCIENTIFIC PAPERS

- I. NORDBERG M, Castrén M, Lindström V. Primary Trauma Triage Performed by Bystanders: An Observation Study. *Prehospital and Disaster Medicine*. 2016, 31(4), 353-7.
- II. Ekström A, Kurland L, Farrokhnia N, Castrén M, NORDBERG M. Forecasting emergency department visits using internet data. *Annals of Emergency Medicine*, 2015, 65(4), 436-442.
- III. NORDBERG M, Eriksson O, Ekström A, Castrén M, Lindström V. News Media sentiment and Emergency Department attendance. Manuscript.
- IV. NORDBERG M, Erså Z, Kurland L, Lindström V. Calls to the Swedish Telephone Advice Service - outcome and compliance. Manuscript.

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LIST OF ABBREVIATIONS

AMI	Acute Myocardial Infarction
ARIMA	AutoRegressive Integrated Moving Average
CPR	Cardio-pulmonary Resuscitation
DiD	Difference-in-Difference
EMS	Emergency Medical Services
ED	Emergency Department
GP	General Practitioner
HL	Health Literacy
HBM	Health Belief Model
ILI	Influenza-Like Illness
M5P	M5 Prime
MAE	Mean Absolute Error
MAPE	Mean Absolut Percentage Error
OHI	Online Health Information
OLS	Ordinary Least Squares
PC	Primary Care
RI	Respiratory Illness
RMSE	Root Mean Squared Error
SCC	Stockholm County Council
TAS	Telephone Advice Service
VAL	VärdeAnalysLager (Value Analysis Repository)

1 INTRODUCTION

My early days as a junior physician in a surgical department, in a small rural hospital, were often spent in the emergency department (ED). And already then, now 15 years ago, I started thinking about why certain days were busier than others. The weekly periodicity, where Mondays tend to be the busiest day of the week, was simple to figure out, as I served all days of the week, days and nights. But what made an expected calm Thursday busy as a Monday? Curiosity and a wish for deeper understanding of my patients' decision-making, especially for the non-urgent patients who had the time to choose both what level of care and when to seek it, is what have led to this thesis.

I argue that physicians in a busy, but well-functioning, ED require an understanding of the patient flow, both to the ED, in the ED and throughout the hospital and health care system in large, besides of course medical and people skills. Therefore, further knowledge of patients' rationale of health care decisions is crucial. Nevertheless, decision-making processes of ED patients has not, to date, been thoroughly studied. In fact, little is still known about what factors that influence the decision of patients to seek care in the ED.

Experiences from both colleagues and myself indicate that patients' reasons to seek emergency care are not always purely medical. Pain or anxiety for one's health is said to be the two only reasons for a patient to do so. While this may be true in one sense, the final decision to seek care in the ED seems to be influenced by many other factors, internal or external, and may not be directly connected to the patients' health or to health at all.

The aim of this thesis, is to explore different factors modifying ED inflow, and with that, to explore factors associated with the decision to seek medical attention in the ED, if such decisions-making is connected only to the medical conditions of the patients, or if it rather is a combination of anxiety for one's health, how the health care system in which the patient lives is structured and other non-medical factors.

The thesis presents four of the studies I have conducted throughout my time as a doctoral student, place the results of the studies in the context of the knowledge base of today and finally suggesting a means of understanding the decision-making of the ED patient using the Health Belief Model (HBM).

2 BACKGROUND

The background chapter of this thesis aims to describe and explain how the inflow of patients to the EDs is structured and introduce the HBM. What known causes there are for a patient to visit the ED, what factors are known to affect the decision of seeking ED care and what effect specifically large volumes of concurrent patient can have on the ED operations and patient safety are explained in this chapter.

Initially, focus is set on the ED patient, to explore what is known about patients in the ED; why he or she seek care there, what measures the patient has taken before coming to the ED, what the socioeconomic profile of him or her is and what factors are known to influence the decision to go to the ED.

In the next section, the effect of when demand for ED care exceeds maximum capacity, called ‘overcrowding’ will be described.

After overcrowding, findings on forecasting of the ED inflow will follow. Forecasting can be used for tactical and strategical planning of ED operations, but building forecasting models will also teach us what factors are important to understand fluctuations of ED inflow.

Subsequent to the forecasting follows a short section presenting knowledge on how laypersons assess illness. In order to understand the decision-making of persons thinking about seeking care in the ED it is crucial to understand how laypersons perceive disease or illness and how this can be viewed upon and measured.

The role of news and social media in a patient’s health care decisions will be explored in the following section. ED care-seeking and specifically to what extent media has a role in this has not been researched to any great extent, but there are published studies on other kinds of media impact on health behavior that may help build a background for further discussion in the matter.

Finally, in the background chapter, the Health Belief Model (HBM) will be introduced and described. HBM is in this thesis categorized as a way of describing patients’ decision to seek care in the ED and of researching ED inflow further. The model helps explaining which main factors influence patients’ health-related decisions and may be used for making testable predictions. It has seldom been used to describe ED patients’ care-seeking decisions.

In this thesis, if not stated otherwise, the term ‘ED patient’ will refer to the ED patient that has the ability to choose when to seek care in the ED, i.e. patient of lower acuity and patients with a high level of autonomy.

2.1 THE EMERGENCY DEPARTMENT (ED)

In this thesis, the term “emergency department” refers to hospital-bound, EDs for somatic care of adult patients, if not stated otherwise.

The ED is the department in a hospital where patients with emergent symptoms are investigated, treated if possible and eventually admitted or discharged. EDs are usually open 24 hours a day, 7 days a week, all year around. Patients present to the ED with a chief complaint, a symptom, not diagnoses [1]. This distinction is important, as much of the medical research is centered around diagnoses. EDs in Sweden have historically been manned by a large proportion of junior physicians and few specialists. This is changing, as emergency medicine was recognized as a specialty in 2015 and there is now a corpus of dedicated emergency physicians growing in Sweden, a development similar to that of other countries [2].

The meaning of the term emergency department differs between different countries as well as within them. In one case the ED may mean the highest possible level of hospital-bound emergent care, but in another case, it may refer to an out-of-hours primary care facility. Health care systems differ between countries and so does the pathways into the ED. In Sweden for example, anyone is free to seek care in the EDs as wished, while in Norway, a doctor from the primary care must refer the patient to the ED.

Furthermore, the patient mix (including age groups, acuity/triage levels and diagnoses) differs between health care systems, why direct comparisons may not be feasible at all times. The ED operations are affected by the patients coming to the ED of interest, and variations in case mix influence the quality and efficiency of the delivered care in the ED [3].

In Sweden, there are 58 hospital-bound EDs and approximately 2,5 million ED visits per year (2015) for a population of about 10 million [4]. The number of EDs has decreased since 2004, when there were 79 operating EDs in the country [5]. At the same time, the availability of hospital beds has also decreased [6]. Contrary to this, the inflow of patients to the EDs of Sweden has increased. Combined, these trends increase the risk of overcrowding (see Section 2.2), although in an international study, overcrowding in Swedish EDs “is reportedly not a problem”, at least not in 2011 [2, 7]. To keep ED inflow low, and to minimize the risk of overcrowding, Sweden has adopted a strategy where the national telephone advice service (TAS) has an integral function in advising patients to the lowest effective level of care. Combined with a well evolved primary care system for urgent care, these arrangements are supposed to decrease the risk of overcrowding [2]. The causes and effects of overcrowding will be described in the next section.

2.2 OVERCROWDING IN THE ED

Overcrowding in EDs is a world-wide problem, and is extensively explored, still the problem is not mitigated. As for definition of the phenomenon, Richardson et al (2009) described it as:

“Overcrowding occurs when emergency department function is impeded, primarily by overwhelming of ED staff resources and physical capacity by excessive numbers of patients needing or receiving care” [8].

Derlet et al (2000) described the perils of overcrowding as:

“Overcrowding is a potential hazard for patients as well as for the personnel in the ED and mitigating the risk of such situations is crucial for high functioning EDs” [9].

There is an ongoing discussion on whether to call this inequality between demand and capacity ‘crowding’ or ‘overcrowding’. In this thesis, the phenomenon will be entitled ‘overcrowding’ in order to inculcate the seriousness of the matter.

Overcrowding in the ED has deleterious effects on ED operations, ED staff, ED quality and therefore on ED care. Overcrowding increases morbidity, risk of adverse events and errors, delays critical care and cause excess deaths. ED overcrowding also leads to prolonged waiting times for analgesia in the ED [8, 10, 11].

Increasing demand, which cannot be attributed to populations growth alone, and decreasing supply are burdening the EDs [12, 13]. The measuring of overcrowding is common in some parts of the world, but this is however not the case in Europe or Sweden. Furthermore, no common definition of overcrowding has been established. There are measurements that are in use internationally, these include time intervals and patient counts as well as time on ambulance diversion, but no gold standard has been set [14-17].

It is possible to predict overcrowding and there are systems in use for forecasting up-coming overcrowding. Despite this, overcrowding keeps being a problem world-wide. Arrangements in order to mitigate both the overcrowding itself and the effects of overcrowding have been taken throughout the years and there is some evidence that streaming patients to staff teams according to acuity levels is a feasible means of overcoming some of the overcrowding problems. Many other arrangements have been made as well, but sufficient scientific proof for their effectiveness is lacking [13, 18-23]

2.3 THE ED PATIENT

Patients visit the ED for a large number of reasons, somatic as psychological, non-urgent as with high acuity.

The demographic and medical profile of patients seeking emergency care is highly dependent on the setting studied. In this thesis, the setting is presumed to be EDs in developed countries, in a Western sociocultural surrounding, if otherwise is not stated.

In the western cultural sphere and high-income countries there are common denominators of the patients seeking ED care. Among these people, who become patients as they enter the ED, there are also, of course, differences; internal and external. Indications are that internal factors are less important than external factors when seeking care at the ED [24]. For example; when introducing increased payment for ED visits, patients change their care-seeking behavior towards other health-care facilities, but do not avoid seeking care [25].

The reasons for seeking care in the ED differ, as do the cues to action for actually, physically, going to the ED. In an interview study in the United Kingdom (UK), non-acute patients' reason for seeking medical care in the ED was studied. Four different reasons were extracted from the interviews; anxiety over the symptom at hand and familiarity with the hospital or ED, access block to primary care (PC), a perception of the efficacy of the ED services and lack of alternative approaches to the health care [26].

A comparison between non-urgent patients in Swedish out-of-hours primary care and in EDs showed that the ED patient cohort had a more equal gender-mix but was otherwise equal concerning demographic variables. The patients attending the ED had symptoms for which they attended the care provider for a shorter amount of time and was also more anxious regarding their symptoms [27]. The somatic origins of reasons for seeking care in the ED in Stockholm, for non-urgent patients are shown in Figure 1.

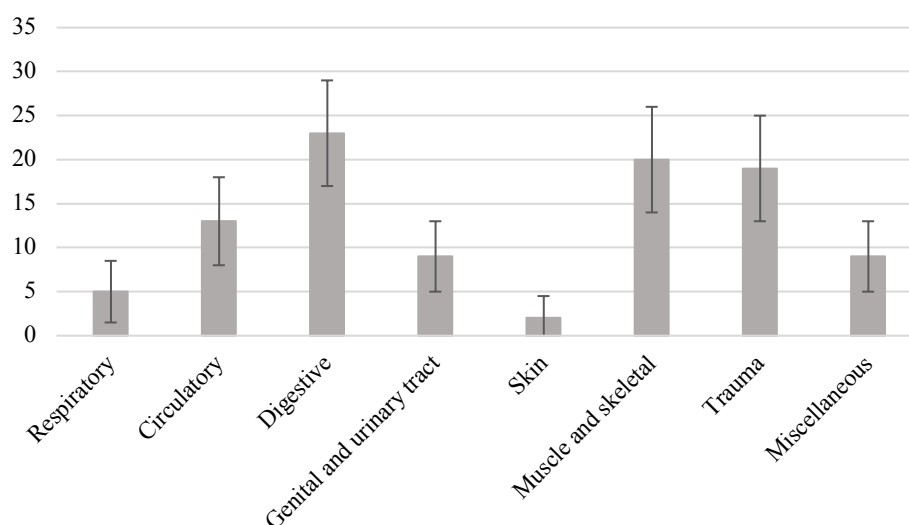


Figure 1. The distribution of chief complaint organ systems for non-urgent patients in the ED (Error bars represent 95% CI) [27].

Patients in an American ED reported self-suspected serious illness (61 %) and being referred (35 %) as reasons to go the ED for health-care. Only 8 % reported convenience, concurrent with other reasons or alone, as the reason [28].

Overall self-perceived health also impact the ED care-seeking behavior, as seen in Figure 2.

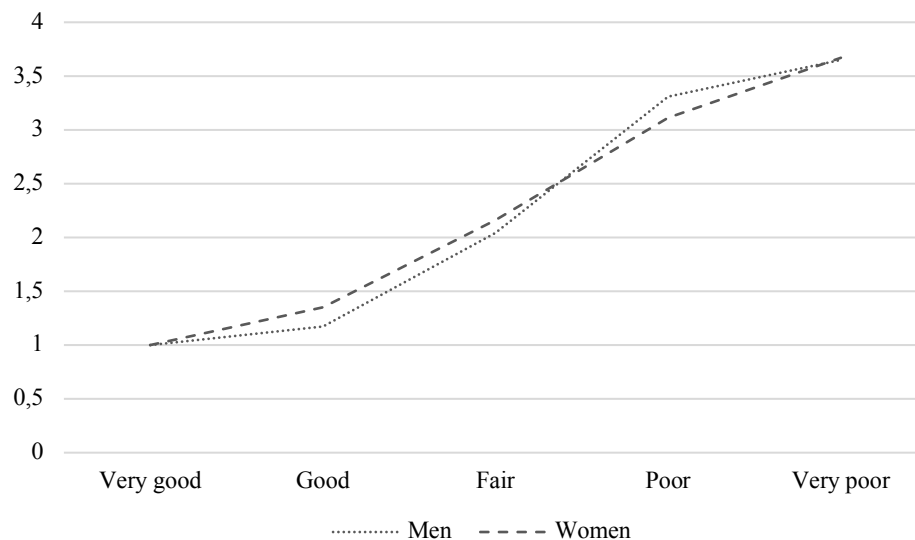


Figure 2. Odds ratio (OR) for ED visits last 12 months over self-perceived health ('very good' = reference category) [29].

2.3.1 Primary care contact

Having an ongoing primary care contact lowers the propensity to seek ED care for non-urgent matters while the lack of such increases it. This is true for both young, middle-aged and elderly patients. Patients without ongoing PC provider relation presented later in the disease process than those with an ongoing PC relation and may therefore be more ill when finally visiting the ED. In elderly patients, the need for ED care is the primary cause for ED visits, but an ongoing PC relation eases the need [30-32]. In a Canadian study, increase of enrollment to general practitioners (GP) with 10 % decreased the rate of avoidable ED visits in that area with 3 % [33].

This implies that interventions to increase PC availability also may decrease the burden of EDs.

2.3.2 Variability of ED inflow

The inflow of patients to an ED is dynamic; it varies with time of the day, day of the week and time of the year as well as with holidays and other factors. Certain patient groups, demographic and acuity-wise, as expressed as e.g. triage level, also seek ED care in different patterns (see Figure 3), but there seem to be no correlation between day of the week and patient complexity [34]. The time variability is described in many studies but differs somewhat between settings, however, the Swedish and Danish inflow to the ED over different time intervals are alike [35]. Mondays are often the most visited day, an effect of the

western cultural sphere which has weekends Saturdays – Sundays. The same effect is detectable after other holidays as well [36].

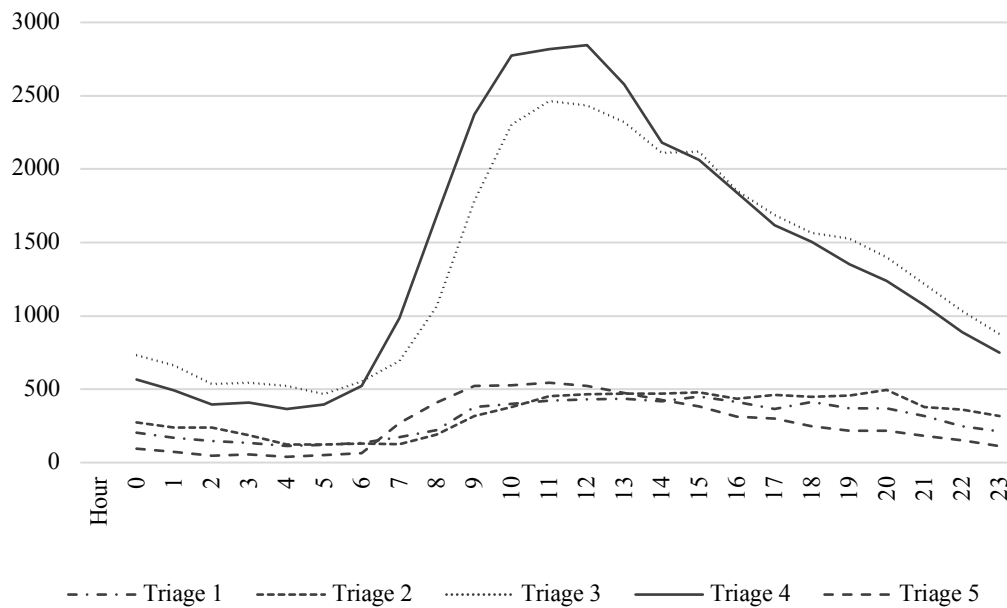


Figure 3. Total number of patients over the hours of the day, for different triage levels (Triage 1 = highest acuity, Triage 5 = lowest acuity). As seen, the high acuity patient-flow exhibits less variance than the low acuity-flow. Data from Södersjukhuset, Stockholm 2017, full year [37].

Apart from time variables as described above, weather factors seem, in many studies, to be affecting ED inflow. In Australia, EDs experience lower inflow of patients during bad weather days than during days of good weather [38]. In Singapore, the highest triage level did not show any weekly or yearly periodicity, but did vary with ambient air quality [39]. A heat wave in Texas during 2011 increased ED inflow with 3.6 %, and of the excess patients most were over 65 years of age suggesting some ED patient cohorts are more susceptible to external influence than others [40]. In spite of this, Wargon et al (2009), have found weather variables to be of low or no value in constructing forecasting models for ED inflow [41].

All the factors that affect variability in the ED inflow are not yet found or fully explored, and models used to predict ED inflow have a maximal explanation level of roughly 80 % (see Section 2.6), thus much of the variability is left to explain.

2.3.3 Socioeconomic status

There is a clear socioeconomic component in the decision to seek ED care. The reason for this is not fully understood. It seems to be independent of affordability of other sorts of care, as within universal public health insurance systems, the differences between people from different socioeconomic groups still persist [42]. Low socioeconomic status seems to increase the risk of avoidable and non-urgent ED visits [43, 44]. La Parra-Casado et al (2018) showed that the odds ratio for all ED visits within the last 12 months was correlated to socioeconomic

status, but men in the poorest group showed less visits than for the second poorest group (see Figure 4) [29]. This was not seen in a previous Italian study nor in a Swedish ditto [45, 46].

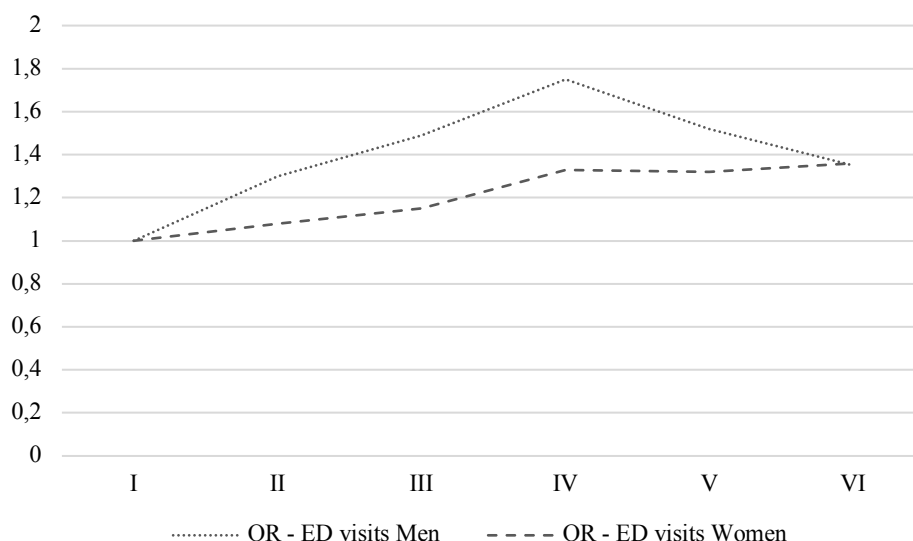


Figure 4. Odds ratio, for ED visits in the last 12 months over socioeconomic status (, I = richest, reference category, VI = poorest), Spain [29].

In a Swedish study, socioeconomic status and distance from a hospital affected the use of and the cost for ED visits, but there was no clear socioeconomic gradient [47]. In other research, the effect of social determinants on ED use is more prominent. Coming from a socially deprived area or belonging to a minority group increases the risk of seeking health-care primarily in the ED, even when taking into account the distance to health-care facilities, whether or not the patient has a GP or the seriousness of the illness at hand [48-50]. The impact of distance to the ED is however variable between settings and studies [49].

The increase of visits to the American EDs during the last two decades, is driven by insured patients, and not, as believed, by the uninsured [51]. This is consistent with findings from Singapore where frequent ED users were shown to have more comorbidities and higher age than non-frequent ED users, regardless of socioeconomic differences [52]. This is, in turn, consistent with other findings where differences in ED seeking behavior is linked to a socioeconomic gradient in health rather than other socioeconomic factors [53].

The patient's trust in the physician also steers care-seeking behavior and this trust seems to be higher with patients from low socioeconomic status than those from higher ditto [54].

The socioeconomic differences in ED care-seeking is not fully explained. Socioeconomic differences in health status might be one of the integral parts [53] and care-seekers' health literacy is most probably also one of the explanations.

2.3.4 Health literacy

Health literacy (HL) is defined as "a persons' capacity to obtain, process and communicate information about health" [55, 56]. For the last one and a half decades, HL has been shown to impact many health-related outcomes. For the ED setting, and ED care-seeking behavior in

particular, HL is a concept that have to be explored further but some indications are already clear.

A study of patients with chronic diseases in the ED showed that comprehension of the disease was strongly inversely correlated to the frequency of ED use [57]. This is in line with other findings where low HL, both for adult patients and for caregivers to pediatric patients, is correlated with higher ED use and lower self-perceived health [58-63]. In a pediatric ED setting, parents with low HL could not sufficiently assess the acuity of their children's condition [64]. Low HL also correlates with low adherence to ED discharge instructions, and a higher risk of re-admission [65, 66].

Between 15 – 40 % of ED patients are considered to have a low HL [67]. Not having English as first language, being male, of low socioeconomic status and education was correlated with low HL [62, 68] in an English speaking context. The results are consistent with the findings of Sarangarm et al (2017) who showed that 93 % of Spanish speaking patients in an American ED were considered to have low HL [69].

The findings described in this section implies that HL may be a key component in the decision to seek ED care.

2.3.5 Actions taken before visiting the ED

Multiple external factors influence the decision to seek ED care. What the patient does before making the decision to seek ED care is important to the outcome; who he/she contacts, what information is being sought and what other health care contacts are taken.

In a Swedish setting, the ratio of non-urgent patient in the ED who had contacted the TAS or PC first, varied between 49 – 80 % [70-72]. Age and socioeconomic status did not affect this behavior, but longer symptom duration and female sex decreased the risk of a direct ED contact without previous other health care contacts [71, 72]. In international studies the proportion of patients seeking professional advice before going to the ED range between 25 % - 40 % and those who had contacted their GP first were admitted to the hospital in greater extent than those who had not [73, 74]. The difference between Sweden and other countries in this regard is not explained, but a focused work for increasing TAS and out-of-hours PC facilities in Sweden may be part of the explanation [2].

Parents try to seek medical advice before seeking medical care for their children to a high extent, but socioeconomic status and perceived acuity affect the decision in favor of direct ED care-seeking [75].

A total of 25% of the patients searched the Internet for health information before attending the ED, a practice that was more common in younger patients. For parents to pediatric ED patients, that number is higher, 52 %, which is plausible as pediatric ED patients' parents mean age is most probably lower than the mean age of the adult ED patient group. Most patients research symptoms (62 %), rather than their diagnosis (41 %). The information,

however, changes the decision about seeking care in only 3 % of the cases with younger patients being more susceptible. [76-78].

It seems that a large proportion of ED patients have tried to find information and/or asked for advice about their health care problem. How health information is being interpreted by the patients is affected by HL and their subsequent decision to seek care therefore is dependent on both what information is sought and obtained and how this information is processed [79]. This means that some patients will do what is considered ‘right’ from a health care system point of view, while some will be ‘wrong’.

2.3.6 Right and wrong patient

ED staff often talk about how non-appropriate ED visits have increased over the years, implying the patients are not sick enough to be in the ED. The term “non-appropriate ED visits” has not been definitively defined, although studies have been conducted trying to quantify the problem. In one of those studies, 53 % of the patients were assessed as inappropriate by their ED physician. Patients regarded as appropriate for the ED were to a larger extent older than 40 years of age and had regular previous health care use [80].

The partitioning of ED visits as appropriate vs non-appropriate has met criticism, as this reasoning is blaming the patient for making the wrong decision and not the health care system for not providing sufficient information and/or alternatives to the ED. A majority of non-urgent patients in an American ED reported insecurity about alternative health care providers for their current problems. To what extent non-urgent patients are a problem in the EDs or if they are a problem at all has also been questioned [81-83].

Patients’ ED care-seeking behaviors are, as mentioned, to a high degree influenced by external factors, even by media reports.

2.4 MEDIA AND HEALTHCARE-SEEKING

What is conveyed in news and other media also affect people’s decisions regarding health-related issues. Media consumption differ among patients, not at least in respect of their sociodemographic belonging [84]. The effects of media on health issues have been observed and investigated in regard to focused media campaigns on vaccination and anti-smoking, as well as the impact of health-related news on health and health care related behavior.

May et al (2016) have also shown that indirect exposure, such as intense media exposure, to traumatic events can lead to psychological disorders as Post-Traumatic Stress Disorder. It is plausible to deduce that other non-health related media exposure may at least impact on health related behavior [85].

Media focus on mental health issues, such as suicides, has been shown to influence ED care-seeking behavior in the mental health care sector [86] and a mass media campaign aimed at

increasing awareness of mental health services in Canada lead to higher inflow at the psychiatric EDs following the campaign [87].

Somewhat contradictory, extensive media coverage of acts of terrorism in America did not significantly increase psychiatric ED inflow, however a shift towards more anxiety-related ED visits was seen [88].

For other kinds of health issues, campaigns aimed at specific conditions seem to have an effect on care-seeking decisions. Campaigns on awareness of stroke symptoms have been shown to increase stroke-related ED visits. Several studies have shown the same effect with public information on acute myocardial infarction and Emergency Medical Services (EMS) use regarding chest pain. In the campaigns effect subsided after the campaigns were ended, leading to the conclusion that messages have to be sent for longer periods of time or be repeated in order to change people's health care-seeking behavior [89-91].

Other kind of media attention might also alter health- and care-seeking behavior; celebrity illness media attention has in some cases been shown to impact health seeking behavior. In 2010, the fatal head injury of a high-profile celebrity lead to a 60 % increase of injury-related pediatric ED visits, and a celebrity suicide in 2012 had the same effects on suicide-attempt related ED visits for adults [92, 93]. In contrast, a high-profile sex abuse case did not increase the ED attendance for that kind of injuries [94].

Other forms of media attention on health or medicine related issues also have an impact on ED inflow. Extensive media coverage of Group A streptococcal testing and influenza outbreaks both increased pediatric ED visits for those matters, [95, 96] while both an E.Coli outbreak and a Cryptosporidium warning led to increased level of ED visits for diarrhea [97, 98].

The time frame for when patients reacts on media coverage with increased propensity for ED visits is not clear, but in the case of increased pediatric ED visits for influenza symptoms it was possible to detect a three-day lag from media coverage to ED increased ED inflow. What is covered by media is also a question of interest. A 2014 study from Belgium showed that mass media followed the patient peaks during the influenza season, and not the other way around [99].

Other forms of more long term media coverage may also lead to altered care seeing behavior as in the case of spiked drinks that might be reflected as more common in the media than in reality. In one study only 15 % of the patients presenting to the ED with suspected poisoning through drinks (i.e. spiked with illegal drugs) actually showed laboratory results consistent with the suspicion, while 60 % had an ethanol serum concentration consistent with significant intoxication [100].

Also, media covered sports events may have an impact on ED inflow, but as opposed to the cases described above, this effect is probably more imminent and noticeable while the event is in progress. It is described that during the 2010 Olympic game ice hockey final on a

Sunday, the number of visits to the ED in Ontario, Canada, sunk significantly compared to the six surrounding Sundays. The relative decrease during the hours for the hockey game was 17 % and primarily affected the patient group classified as men with low acuity chief complaints [101].

There are only a few studies on the effect of media attention on ED visits and ED inflow, and quantification on the size of the effect and when it occurs is not known, nor is the type of media coverage studied. In the studies conducted, negative media reporting is primarily assessed and linked to increase in ED inflow, but what effect positive news or other media coverage have is not studied in this respect. There is also a lack of knowledge on whether general news, with no health issue focus, impact peoples' propensity to seek ED care.

2.5 LAYMEN ASSESSING DISEASE

In low-and middle-income countries task shifting different health care tasks from expertise personnel to less qualified ditto or layperson has been, and is, a recommended way of reaching or maintaining a full health care workforce [102, 103]. Task shifting has been proved to not increase risk or decrease safety of care in special circumstances, including trauma care [104].

While task shifting has been introduced for countries with limited resources, in high-income countries shortage of resources can still arise, for rural areas as well as in urban more densely populated areas, depending on the acuity of the matter. For cardiac arrests occurring in public places with no health care at close hand, it has been shown that layperson cardio-pulmonary resuscitation (CPR) increases the chance of survival [105].

In order to increase the value of laypersons in health care, training and education seem to be needed. Laypersons receiving training in Basic Life Support are more prone to perform CPR than before the training, and the willingness increases with the number of trainings received [106]. Also, in task shifting for lay health personnel education is necessary [102, 107]. However, education alone does not explain differences in lay person's involvement in health care situations, especially in emergent events. For example, older laypersons are less prone to resuscitate cardiac arrest patients than younger [108] and limited knowledge of the suspected illness prevents involvement [109].

Little is known regarding how patients identify their illness in connection with an ED visit, the literature does not give much guidance. It has been shown that 29 % of ED patients searching the Internet for a diagnosis that they themselves suspected, before coming to the ED, got that diagnosis after an ED visit [77]. Patients seeking care in the ED was in one Swedish study considered to be at the appropriate level of care in 60 % of the cases [80]. In 2010, Strategy for Off-Site Rapid Triage was developed to relieve the health-care system from overcrowding of patients with influenza-like symptoms. This triage system lets the patient themselves triage their own illness before seeking medical attention. It has been validated for pediatric patients, showing a high sensitivity, while lacking in specificity [110],

111]. This might indicate, but does not prove, that patients, with some help, may assess the severity of their own illness. In addition, laypersons, as e.g. relatives, are important as advisors in the ED care-seeking decision and their perception of illness severity is therefore of interest [24].

In summary; it seems possible to teach laypersons to identify and handle illness, but the literature on how care-seekers (laypersons) assess their own illness in regard to acuity and/or diagnosis is scarce.

2.6 ED INFLOW FORECASTING

There is predictability in ED inflow variability and understanding this variation is essential to overcome overcrowding [13]. ED inflow forecasting has been a subject of scientific studies for about 20 years [112, 113]. A multitude of different mathematical models and a variety of variables have been used to try to predict future inflow for both longer and shorter periods. In Table 1, a selection of different models is presented.

Forecasting the ED inflow may allow for better planning of resources; human, economic and technical. This in turn may, if used right, lead to less queuing in the ED and less overcrowding [114].

Beyond using ED inflow forecasting to save resources and mitigate overcrowding, it may also be useful in syndromic surveillance, as outbreaks of disease may first be seen in the EDs. Expected number of patient per day, either for the whole ED population or for specific symptom combinations, can be computed and compared to actual outcome, facilitating the detection of irregularities in inflow [115, 116].

Variables	Model	Forecasting scope	Explanation level	Accuracy	Reference
Season, week of the month, day of the week, holidays, federal check-delivery days, high temperature and snowfall	Linear regression	Daily	87 %	NA	Holleman et al (1996) [112]
Day of the week, month of the year, holiday/weekday, relative order in the dataset and the inflow of each day in the historical data	Analysis of covariance	Daily	65 %	MAPE 10 %	Rotstein et al (1997) [113]
Day of week, month, public holiday (yes/no), weather (temperature, humidity and pollution standards index)	ARIMA	Daily	NA	4.8–16.8 % depending on triage level	Sun et al (2009) [39]
Official holidays, school holidays, day of the week, month and trend	Generalized Linear Modelling	Daily	50 %	MAPE 5.3 % for a whole region	Wargon et al (2010) [117]
Weather and calendar variable	Seasonal-ARIMA	Daily	NA	MAPE 7.4 %	Kam et al (2010) [36]
Calendar and weather variables	Seasonal-ARIMA	Daily	NA	MAPE 11.7 %	Marcilio et al (2013) [118]

Table 1. Different variables used and the accuracy of ED inflow forecasting models. ARIMA = Autoregressive Integrated Moving Average. MAPE = Mean Absolute Percentage Error. NA = Not Available.

2.6.1 Explanatory power and accuracy of forecasting models

Forecasting accuracy can be measured in many ways, in ED inflow forecasting, the most common ways are:

- Mean Absolute Error (MAE)
 - The unsigned difference between forecasted value and actual outcome. This gives a good understanding of the error in the specific model, but makes comparisons between different settings difficult as MAE is dependent on the inflow to the specific site (scale-dependent).
- Mean Absolute Percentage Error (MAPE)
 - The unsigned relative difference between forecasted value and actual outcome. This makes it possible to compare models over different settings, but MAPE has some major drawbacks; it is highly influenced by outliers and in discrete time-series the error might be unduly large. E.g. a forecast of 2 visits during one hour when the actual value is 1, will give an error of 100 %.
- Root Mean Squared Error (RMSE)
 - The root of the mean squared difference between forecasted and actual outcome. RMSE is, as MAE, scale-dependent. Unlike MAE, RMSE will increase as the distribution of the error frequency increases, making it a better choice for evaluating models where large, but few, errors are more unwanted than small and evenly dispersed. Also, large errors will have a larger impact on RMSE than on MAE.

The accuracy of the ED inflow forecasting differs between models, settings and variables used as well as with the time frame of the prediction. The longer the time frame of interest, the better the results, expressed as MAPE. The utility of the model is dependent on what the model will be used for; for economic-strategical planning, forecasts on the coming months or years may be suitable, but for more tactical planning and avoidance of congestion in the ED, shorter time frames must be used, compromising the accuracy of the prediction. Forecasting models predicting the near future on an hourly basis reach an error of approximately MAPE around 25 % [119] and on a day to day basis 5 – 15 % [39, 41, 120]

Forecasting inflow of walk-in patient is less difficult than predicting ambulance arrivals, which is most likely due to the stochastic nature of emergent cases. Since lower acuity cases have a chance of deciding when to seek ED care, the forecasting becomes more of a forecast of human behavior than that of emergent disease. For example, Sun et al (2009) showed the following MAPE for forecasting daily inflow of highest, intermediate and lowest acuity levels: 16.8 %, 6.7 %, 8.6 %. Total daily inflow was predicted with MAPE 4.8 %. Also, in another study daily inflow could be forecasted with MAPEs of 6.07 – 9.73 % for individual hospitals in a region, for the region as a total, MAPE was 3.89 % [39, 117, 121, 122].

In most studies of ED inflow forecasting the models explain between 55 – 80 % of the variation [41, 112, 113].

2.6.2 Different forecasting models

To date, the most commonly used mathematical model for forecasting of ED inflow is AutoRegressive Integrated Moving Average (ARIMA) [123]. In a review of the then-current literature, Wargon et al (2009) concluded that linear regression and ARIMA were the most common forecasting models [41].

ARIMA was developed by Box and Jenkins in the 1970s and have since been used for different time series modelling purposes [124]. It became mainstream in ED inflow forecasting during the 1990s and is the number one choice of time series modelling for ED inflow forecasting.

Interestingly, around the year of 2015, forecasting models presented in scientific literature shifted from common regression models and ARIMA ditto, to more advanced machine learning methods.

In 2015 Vector-ARIMA model was shown to produce better forecasting than standard ARIMA model for long-term forecasting in Australia [125]. Machine learning techniques such as support vector regression models and M5Prime (M5P), a decision tree model for machine learning, for forecasting 8 hour-periods up to two weeks ahead, were superior to other regression models and sufficiently well performing to be used for staffing purpose, which earlier had been establish not being the case [41, 126].

Furthermore, with machine learning techniques such as deep neural networks, hourly ED inflow could be forecasted with a MAPE of $\sim 20\%$ and daily ED inflow with MAPE around $3 - 4\%$ [119, 127].

2.6.3 Variables in forecasting models

Independent / explanatory variables which have been used in forecasting models range from historical number of visits through weather forecasts to football games occurring. Most forecasting models rely on historical data on inflow rather than on dynamic variables, mirroring the now, and more importantly not factors describing healthcare-seeking behavior of the population of interest.

The most predictive variable for daily ED inflow is weekday [41], but many others have been included in models and in some cases improved the model's performance. In Table 1 variables included in various models are shown.

More dynamic variables to predict ED inflow have scarcely been used. TAS calls concerning respiratory illness (RI) in Ontario, Canada, correlated significantly with ED visits for RI [128]. Using TAS calls about RI as an independent variable in forecasting models predicting RI visits to the EDs produced good results for large volume EDs, when modelling with Fast Orthogonal Search, while linear regression was as good as more advanced modelling options in smaller units [129].

The lack of dynamic variables mirroring health care-seeking behavior was to some extent mitigated when Ginsberg et al (2009) showed that flu pandemics could be followed by tracking search queries for symptoms online the Internet [130].

Applying this approach to forecasting ED inflow of all sorts of patients presents several challenges, with the selection of variables being the most difficult to overcome. While the flu or other trackable diagnoses have a set of symptoms that will be consistent with Internet searches, the ED patient may present with almost any symptom known to man. Therefore, other data points depicting a populations propensity to seek health care and, if possible, more specific ED health care have yet to be identified.

Cervellin et al (2017) illustrated this difficulty when studying the epidemiological value of Google Trends, showing little or no correlation between seeking-patterns on the Internet and more conventional epidemiological data [131]. The search terms for each disease may not be what the clinician would expect. This problem was also expressed in an overview of studies using Google Trends as a mean to assess digital / online epidemiological data, where many of the results in the included studies were not reproducible [132]. However, using online generated data as Google-queries and Twitter messages have, in certain regions, been shown to improve forecasting models for specific influenza-like illness (ILI) ED visits [133, 134]. As an intellectual steppingstone for this, it has been shown that patients at EDs seem to write about their illnesses on social media [135]. Interestingly, one study showed significant correlation between the number of alcohol related tweets in the state of interest and the numbers of alcohol related ED visits in the same state [136].

2.7 TELEPHONE ADVICE SERVICES (TAS)

The primary role of a telephone triage or TAS is to stratify the caller's risk of severe disease and point the callers to the most proper instance of the health care system at hand, streamlining the health care system and increasing the quality for the patient (for a schematic picture, see Figure 5). There are some evidence pointing towards this also is what a well-functioning TAS actually does [137].

TAS have been common in many countries since the 1980s and the availability has been rising during the years [138-143].

While the role is given, the outcome is highly dependent on whether the callers comply with the advice given, and compliance is dependent on a multitude of factors, and amongst those, caller satisfaction. Some studies suggest that what advice is given also steers the level of satisfaction of the patient [144].

The right resource at the right time at the right level of care

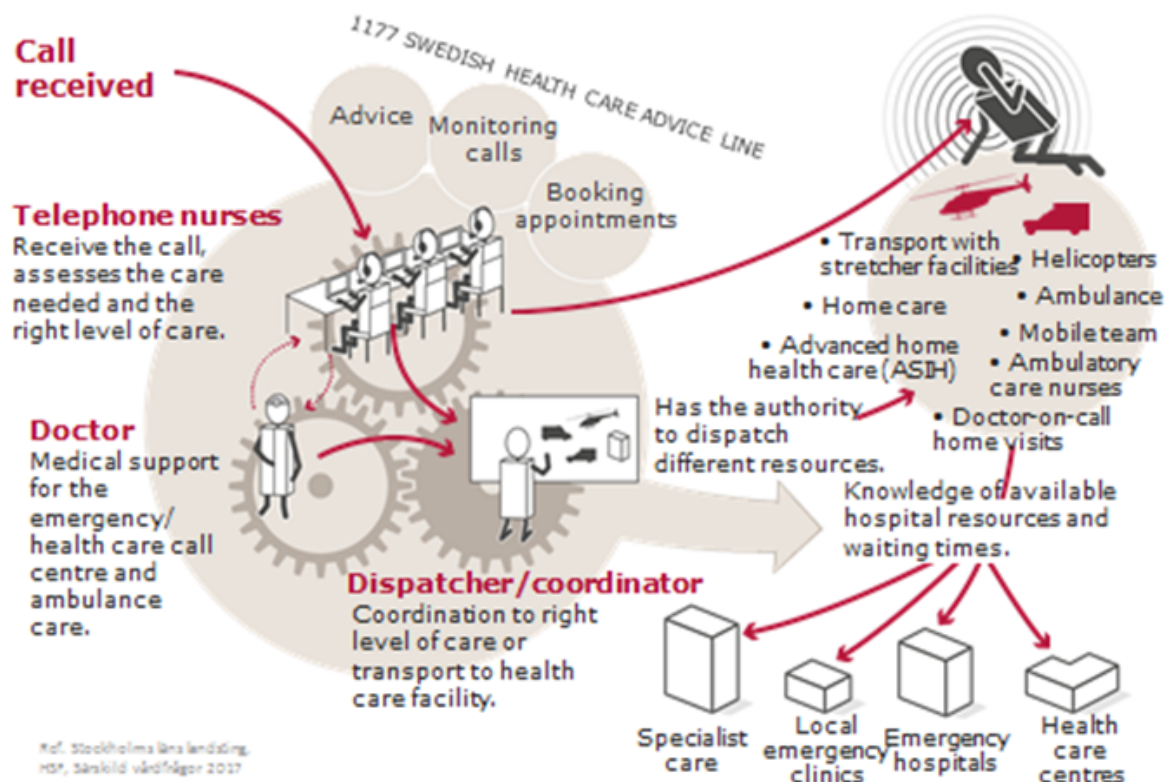


Figure 5. The health care system in Stockholm County, Sweden, where TAS has an integral role. Picture used with permission from the Stockholm County Council.

2.7.1 The caller and reasons for calling

A majority of TAS users are women, except for in the youngest age groups, where the proportions are equal. The overweight of women to men is most prevalent in the middle ages (see Figure 6). Most calls concerns infections, especially in the younger age groups, and most calls are made during out-of-office hours. In older age groups questions concerning medication and requests for administrative advice are more common. In total the five most common causes for calling are 1. Infections 2. Chest or abdominal pain 3. Inquiries about telephone numbers 4. Symptoms of trauma 5. Skin or allergy. Approximately 30 % of the calls are made for someone other than the caller, where parents calling about their children is the most common [145-149].

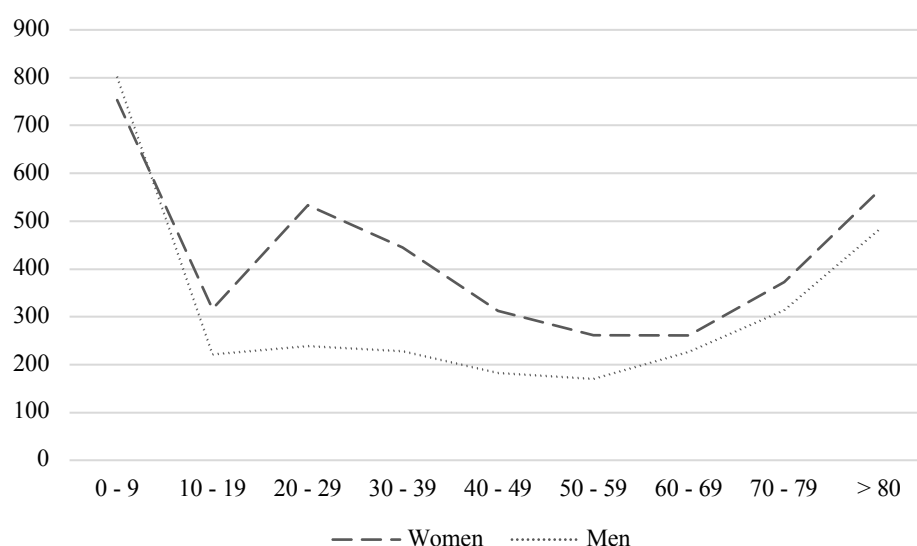


Figure 6. The incidence (number of calls per 1000 inhabitants) of callers to the Swedish TAS over age groups (years). From Dahlgren et al 2017 [148].

2.7.2 The advice given

The outcomes / advice of a call to the Swedish TAS can be one of the following; self-care, out-of-office primary care, ED, no advice, medical specialist, on call doctor or nurse, ambulance, medical evaluation and redirection to another call handler. Variants of these are present in most of the TASs studied [138, 148, 150].

The rates of advice given vary between settings and over time. In a Swedish study from 1999 49 % of the callers got the advice self-care and 6 % the advice ED [147]. Older age is a predictor of advice to seek emergency medical care [145]. The rates of referral to a higher (secondary) level of care were for most chief complaints the same among women and men [148]. In Scotland in 2015 out-of-office primary care (34 %) was the most common advice followed by on-call doctor (12 %) and then self-care (10%) [150].

2.7.3 Compliance to advice

The effect of a TAS is closely linked to the compliance to advice of the patients, and compliance has been shown to vary. In a Swedish study from 1999, 85 % patients self-reported compliance to the advice given [147]. Overall compliance (all advice) has been reported to be 60 – 90 %, and for the ED advice 52 – 69 %. Self-care advice adherence has been reported to be approximately 85 %. In a review of the literature, compliance to ED advice was “slightly higher” than for the self-care advice [140, 151-154].

Going to the ED despite receiving a different advice has been shown to be relatively uncommon in two studies (2.4 – 9 %) [140, 154], but common in one study (>50 %) [140, 154, 155]. The reason for this discrepancy is not known.

Several factors impact compliance. Living in remote or rural areas and having high levels of psychological stress has a negative effect on the compliance to the ED advice, while it was positively affected by known positive life style factors, initial own intention to visit the ED,

calling after-hours, by being adult over 45 years of age or infant under the 12 months of age, higher income, higher satisfaction with the call and some specific chief complaints such as cardiac issues [151-153, 156]. Callers who were content with the telephone call are more likely to follow “self-care” advice. Calls ending in non-compliance are more often a result of poor communication in the consultation and patients’ perceptions of the call [151]. Four sources of dissatisfaction in TAS calls has been identified: 1. Advice issues 2. Process aspects 3. Nurse lack of acknowledgement 4. Access issues [144, 157].

There are also indications that high self-efficacy increased adherence to self-care advice, while compliance rates to given telephone advice decreased with distance to ED [141, 158].

2.7.4 Effects of TAS

A Cochrane review concludes that TAS seem to ease the burden of surgery contacts and out-of-hours visits at PC facilities. However, other effects such as service use and patient satisfaction need further investigation [159]. This was somewhat contradicted in a later review where the evidence for TAS easing the burden of EDs was considered scarce [8], although the latest review to date is again pointing towards positive effects as lessened burden on other clinics, high patient satisfaction with the services and no safety risks [137].

Unsurprisingly, TASs seem to decrease the number of telephone calls to the EDs, but may increase ED visits [70, 160, 161]. The reason for the increase in ED visits have been reported as over-triaging. However, recent research has shown that a telephone triage line can distinguish suitable ED patients from non-suitable ED patient with high accuracy [162] a result in conflict with previous findings [155, 163]. Furthermore, a telephone advice line manned by a GP was shown to reduce the number of ED visits, for callers who had initially intended to go to the ED before calling the advice line [164].

The full effect of TASs on the ED inflow is yet to be determined.

2.8 HEALTH BELIEF MODEL (HBM)

The health belief model (HBM) is a theoretical framework to understand and explain individuals’ health promoting behavior and to construct interventions. The model was presented by Rosenstock et al (1966) and has been widely used to understand behavior as well as to design interventions for a health promoting behavior [165-167].

The model consists of six parts (constructs) which affects a persons’ decisions about his or her health (see 2.8.1). The constructs are *Perceived Seriousness*, *Perceived Susceptibility*, *Perceived Benefit (of the action)*, *Self-efficacy*, *Cues to action* and above that *Modulating factors* (see Figure 7) [55].

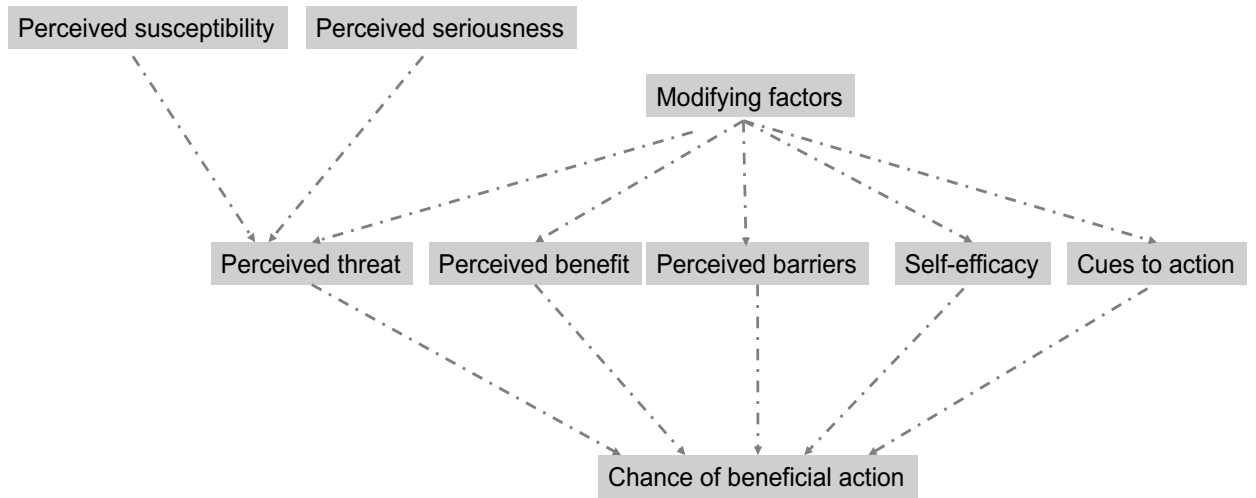


Figure 7. The constructs of the HBM and their mutual relationships

2.8.1 HBM constructs

Perceived threat

Perceived threat consists of the two sub-constructs; Perceived severity and Perceived susceptibility. Perceived severity is the person's belief of adverse health outcome associated with the certain disease or condition at interest. Perceived susceptibility describes the person's own beliefs about the health risk's or disease's chance of affecting him or her specifically. If this chance is believed to be zero, the chances of the person acting to mitigate the risk is also zero.

Perceived benefits

Perceived benefits translate to the person's beliefs of the action giving positive effects.

Perceived barriers

Indicates the barriers, real or psychological, to taking the actions needed for the benefit of the person's health.

Self-efficacy

Self-efficacy is the person's own belief in his or her ability to carry out the changes or actions that are needed to improve health [55].

Cues to action

Cue to action is an event, e.g. a specific symptom or a combination of many, an appeal from a friend or media coverage of a certain disease, that triggers the person to take action to mitigate risk of adverse health outcome.

Cues to action has not been assessed empirically as a part of HBM [55], but in a number of studies, cues to action has been identified and its impact quantified. For example, in a study on cervical cancer screening in Hispanic women in America, Spanish media, reminders from mothers and reminders from physicians were identified as cues [168]. Cues to action was also important in ushering persons to start safe-sex behavior in the study by Mattson (1999) [169] and also in Kamimura et al (2016) [170] where the most common cue to action for participating in a health education program was “recommended by provider” [170].

Modifying variables

Modifying variables include, but are not restricted to, demographic factors. Modifying variables can be both internal and external and studies have shown impact of age, sex, socioeconomic factors, education, health care access, ethnicity, earlier diseases and illnesses, country of origin, prognosis of ongoing disease and influence from others [54, 170-173].

2.8.2 Examples of HBM use

The HBM constructs have been shown to be measurable with questionnaires, rendering the model valid for use [174]. As an example of use; in a Swedish study HBM was used to model parents’ intention to participate in a parenting program. The study showed higher intent to participate with higher self-efficacy, lower perceived barriers and higher perceived benefits. Parents of children with behavioral problems had a higher score on perceived benefits, resulting in higher intent to participate in the program. The behavioral problems of the children of those parents can be regarded as modifying factors [175]. Thus, HBM can be used to construct models of health behavior and to predict the actions of patients. In several studies on various health related issues, HBM have been applied and valuable as a theoretic groundwork for understanding and modelling:

- Health beliefs (perceived severity, perceived barriers and perceived susceptibility) were significant variables in a prediction model of patient adherence to ED discharge instructions [176].
- Persons safe-sex behavior correlated positively with perceptions of the severity of HIV/AIDS, self-efficacy, benefits of safe-sex, barriers of the same and perceived susceptibility [169].
- In health promoting menu labeling in restaurants, HBM was be used to describe the influence this have on consumer behavior; cues to action seemed to affect behavior through the construct ‘perceived threat’ when modelling the impact [177].

- In studying participants in a health education program, self-efficacy had positive effect on perceived benefit and negative effect on perceived barriers for physical activity while the reverse was true for unhealthy eating habits. [170].
- When constructing a model for sleep habits in college students, perceived severity (to too little sleep), perceived barriers (to falling asleep), cues to action (for changing sleeping behavior), and self-efficacy were found significant in the model construct [178].

2.8.3 HBM and the ED

Despite its wide use, HBM has been scarcely used as a framework to understand the behavior of seeking ED care, apart from one study by Walsh (1995) [24]. Recently, Pearson et al (2017) used HBM to construct a questionnaire to understand differences between low acuity patients arriving to the ED in ambulance contra the walk-in patients. This study did not, however, place the patients' ED care-seeking decision within all the constructs of the HBM [179].

The scarcity of theory-based research into emergency health-care issues has been addressed by Trifiletti et al (2005): "Results suggest that the use of behavioral and social sciences theories and models in unintentional injury prevention research is only marginally represented in the mainstream, peer-reviewed literature." [180] and by Ejeta et al (2015) who also addressed the scarcity of studies on the modifying factors in this regard [181]. In a review, Painter et al (2008) recommended the use of this theory as base for health behavior studies [182].

For the discussion in this thesis, I will use the recommendation by Walsh (1995) who studied a general population seeking care at the ED with respect to HBM, and concluded that attendance at the ED is "the end of a logical decision-making sequence" and therefore appropriate to model using HBM [24].

3 AIMS

The overall aim of this thesis is to explore different factors modifying ED inflow, and within this, to explore different modifying factors associated with patients' decision to seek care in the ED, and thereby affect ED inflow.

Specific aims for the included studies were:

STUDY I

The aim of this study was to evaluate whether bystanders with no training in triage can correctly prioritize three injured patients by using a triage instrument.

STUDY II

The aim of this study was to investigate whether web site visits to an online health care guide (1177/Vårdguiden) could be used to predict ED attendance for the next day.

STUDY III

The aim of this study was to assess the effect of newspaper headlines sentiment, as a proxy for unrest in the surrounding world, on ED inflow in Stockholm County, Sweden.

STUDY IV

The overall aim of this study was to assess the association between age, gender and socioeconomic status (SES) and outcome and compliance of the calls to the Swedish TAS 1177.

4 ETHICAL CONSIDERATIONS

In only one of the four included studies in this thesis ethical vetting was needed, for the other three studies the design was such as ethical permission from the Ethical Review Board was not called upon.

For Study I the study design was such that it followed the guidelines of International Council of Nurses (ICN, Geneva, Switzerland) for questionnaire studies [183]. The participants were ensured of anonymity, confidentiality and integrity.

For Study II and III no ethical vetting was necessary as no interventions were performed, all patient-correlated (ED inflow) data was aggregated to hour and daily aggregates for each ED and for the county as a whole. The ED inflow data was also publicly available, and all analyses were performed retrospectively. Neither was the data on website visits and news media headlines of the nature that ethical vetting was needed.

Within the Privacy Laws of Sweden [184] personal data is defined as "all sort of information that directly or indirectly may be attributed to a living physical person" (authors translation) and in the 13§ of the same law what is regarded as sensitive personal data.

The aggregated data being handled in Study II and III contained only date, hour, the number of website hits and the *number of patients* seeking care at the different EDs respectively. The data was also collected aggregated from the county councils administrative data warehouse (VAL). No more detailed data was available to the researchers during the process. Thus, the data used in the research could not be labelled as personal data or sensitive personal data and therefore ethical vetting was not needed for these studies. The Privacy law was later changed since May 25, 2018, and the new law may have required the research to undergo ethical vetting [185]. Studies II and III were, though, both conducted before this date.

For Study IV, as being a part of a larger research project, the Ethical Review Board in Stockholm approved of the study (Reg.no. 2017/205-31). In addition to this all data was delivered in an aggregated form, and there was no possibility for the researchers to identify any individual patients.

The circumstances described above are the within the laws and regulations of research in Sweden, nevertheless additional ethical considerations were carried out within the research groups and between the PhD-student and the supervisors.

Two questions needed to be answered before undertaking these studies, even those which were not obligatorily subjected to ethical vetting; 1. Is the time and resources well spent doing the research, are the eventual results and learnings worth it? 2. Is there a risk of harming, even if using publicly available data? For the first question the answer was obviously 'yes', as the resources and time spent on the projects were small compared to the eventual applications the results could lead to.

For the second question, the issue is interesting. In an article in *Nature* [186], Gibney raised the question if research projects using only publicly available data should always be granted. Examples of data science research projects using only publicly available data, where ethical vetting had had no objection, with results that could be considered unethical were given in the article, e.g. the case of a research project teaching an artificial intelligence to assess whether or not a person on a picture was homosexual [187] and one case where researchers had used other kind of data publicly available on the Internet to work out the identity of a secretive graffiti-artist. The Gibney article is published years after study II and III, but the discussion before and during the projects were of the similar nature within the research group. Especially for Study II, where we had to consider that every study on assessing human behavior with online data might be taking us closer to a reality where individuals can be omni potently tracked and assessed online. The author group concluded that the study at hand was not an immediate risk to personal integrity online.

5 METHODS

Two study designs were used in the studies of this dissertation. An overview of study designs, populations, data collections and analyses for the four papers are given in Table 2.

Study	Design	Population	Data collection	Data analysis
I	Prospective survey	69 participants	Questionnaire	Descriptive statistics
II	Retrospective observational	455 days of ED inflow	Pre-existing data records ¹	Linear regression analysis and -modelling, MAPE-analysis
III	Retrospective observational	10 years of daily ED inflow	Pre-existing data records ¹ , news media records ²	Word embedding, ANOVA, ARIMA
IV	Retrospective observational	365 days of calls to TAS	Pre-existing data records ³	Logistic- and linear regression

Table 2. Overview of study design, brief data description and statistical analyses for Study I – IV.

¹ The number of daily ED visits from the VAL-database (see Section 5.2)

² See Section 5.1 and Section 5.2

³ All calls to the Stockholm 1177 TAS recorded in the VAL-database. (see Section 5.2)

5.1 STUDY DESIGN AND SETTING

All studies were conducted in Stockholm County, a region with approximately 2,300,000 [188] inhabitants living in both rural and urban parts. Stockholm County Council (SCC) is responsible for six out of seven EDs, but is funding all seven. The EDs included treat adult patients with primarily medical and surgical symptoms (general somatic EDs). Psychiatric emergencies are treated in separate EDs, as are paediatric somatic patients, and those are not included in the studies at hand. In addition to the seven EDs, there are a large number of PC facilities in Stockholm County, both PC offices and out-of-hours PC emergency centers (OOH). The regional health care guide-website (1177/Vårdguiden) was operated by SCC as well [189] and so is the TAS.

In Study I, a prospective study using questionnaires was performed. The study took place during a public outdoors event aiming to show emergency medical services, police services and fire department services to an interested public. In a tent Karolinska Institutet was represented to inform about its research concerning the pre-hospital care. The participants were recruited from the visitors to this tent.

In Study II, a retrospective observational study was performed on the number of all daily ED visits in Stockholm County and on all daily web-visits to the 1177/Vårdguiden health care website during August 13, 2011 to October 31, 2012.

In Study III, a retrospective observational study was conducted on the number of all daily ED visits in Stockholm County and daily news headlines in a selection of printed news media for the same days during the full years 2005 – 2015.

The selected news media were; Svenska Dagbladet, Dagens Nyheter, Aftonbladet and Expressen. Those media outlets constitute the most popular and trusted daily newspapers in Sweden and presumably also in Stockholm County [188]. The printed newspapers Svenska Dagbladet, Dagens Nyheter, Aftonbladet and Expressen had a, self-reported, combined national daily readership of more than 6.7 million readers.

In Study IV, a retrospective observational study was conducted on all calls made to the TAS in Stockholm County during the year 2016.

5.2 DATA COLLECTION

STUDY I

Data collection was performed using survey forms. All participants were presented with a paper where three patient cases were presented. The three cases were describing a road accident and for each case one of the victims was described in detail (see Appendix I). The participants were then asked to use a triage aid (see Appendix II) to triage the three cases in order of severity, filling out a survey form (see Appendix III). Background data on each participant was collected in the same manner. Data was collected during one day in 2010.

STUDY II

Data was collected from SCC and 1177/Vårdguiden respectively. From the SCC, the VärdeAnalysLager (Value Analysis Repository)-database (VAL) was used. VAL is a data warehouse which stores administrative health care data from all health care systems in Stockholm County and is routinely used for analysis and follow up of healthcare in the SCC. VAL covers 99 % of all health care visits, including emergency department visits [190]. From VAL, aggregated numbers on daily ED visits for the period August 13, 2011 to October 31, 2012 were collected for each of the seven EDs within Stockholm County. From 1177/Vårdguiden, daily numbers on (not unique) website visits were collected for the same period of time. 1177/Vårdguiden uses Google Analytics to gain this information and as researchers the team was given unrestricted access to the website visit-data. The reason for not using unique visits to the website was that the study hypothesis was that interest in, or worry for, one's health predicts later inflow at the emergency department.

Thus, an increased number of visits will be a gauge of the health concern of the population within the studied region.

All data in this study was anonymized at collection as only aggregated numbers of visits to ED and website was retrieved, and no personal data was made available.

STUDY III

Data was collected from VAL and from Retriever [190]. Retriever is a private company specialized in retrieving insights from published news media, and stores all media articles published in Sweden in a digital media library. All news headlines ($n = 2,043,697$) from the selected news media (see Section 5.1) during year 2006 – 2015 were collected, stratified on date, hour and news media name. Daily ED inflow for the seven EDs in Stockholm County was retrieved for the same time period.

STUDY IV

Data was collected from VAL. Data on all calls registered to the TAS in Stockholm County during year 2016 (January 1 to December 31) was retrieved. All contacts' age, sex, socioeconomic status, chief complaint, given advice from the TAS. First subsequent physical care-contact was retrieved on an aggregated level making identification of an individual impossible. Socioeconomic status is in VAL recorded using the Mosaic software [149, 191], where habiting location defines the socioeconomic status of the individual person. Outcome was then defined as what advice was given by the TAS and when and where the patients had sought subsequent care, and if that care contact was aligned with the advice given or not.

5.3 DATA ANALYSIS

All studies in the thesis at hand was conducted with a quantitative approach. Descriptive and statistical analysis and graphical representation of the data was made in all four projects, except for Study I where only descriptive analysis was conducted. The threshold for statistical significance was set to $p \leq 0.05$, which is the most common practice [192].

STUDY I

In Study I, descriptive analysis of the demographics of the participants and their answers were used; percentages and means.

STUDY II

In Study II, two datasets were constructed as 'load-per-time unit'. In the case of the EDs, the data was in the form of number of visits per individual ED per day, while website data was in the form of number of visits per hour. Data was subsequently transformed to inflow or visits per day, depending on the data set. A training set of 12.5 months (August 2011 – August 2012) and a validation set of 2.5 months (August 2012 – October 2012) were then constructed.

ANOVA was used to analyze the weekly differences in ED inflow and website visits. A graphical analysis was undertaken to assess the most suitable time frames for predicting

inflow to the EDs the following day. The correlation was tested using Pearson's R. A linear regression model was constructed using the training dataset and the resulting model was tested on the validation set. Web-site visits in the evening before the day of interest, and the same day of the week was used as independent variables. MAPE was used to assess the models' accuracy.

STUDY III

In Study III a sentiment index for news media articles was constructed using word embedding methods and was subsequently used to assess the overall daily sentiment on all news headlines published in the selected news media during ten years. The index consisted of words that, in the headline corpus, were used in the same manner as the word "worry" or "anxiety" (Swedish word "oro"), see Appendix IV. The words were identified by first creating a word projection table, and then, using cosine similarity calculations, identify the words with the highest similarity. The index, named Headline Unrest Index (HUI) was then used to count the daily frequency of those words in the headline corpus, thus creating a daily sentiment time series.

HUI and ED inflow variation over days, months and years were assessed using ANOVA.

ARIMA was used to assess the relationship between news media negativity, that is the HUI, and ED inflow to the seven ED of the SCC.

STUDY IV

In study IV, the relationship between caller characteristics and compliance to given advice was assessed using binominal regression models. For relationship between caller characteristics and outcome of the calls, ordinal logistic regression was used in order to evaluate the individual impact of the different sociodemographic background variables on the advice given by the TAS and on the compliance exhibited by the callers to the advice.

6 RESULTS

In this section, the main results of the four included studies will be presented. Analysis of the results, and discussion of the impact, follows in subsequent sections.

STUDY I

A total of 69 persons participated in the study. A majority of the participants were women (56 %) and ages ranged from 10 – 82 years. 53 % knew CPR and 59 % had experienced accidents, either as victims or as bystanders.

Overall 52 % of the cases were triaged correctly. There was an over-triage (i.e. case triaged as more serious than it was) of 12.5 % and under-triage in 6.3 % of the cases.

The highest rate of correct triaging was seen for the case with the highest nominal seriousness (case #3) while the lowest seriousness (case #2) had the lowest rate of correct triaging. Under-triaging was most common in case #1 (17.4 %) and rarest in case #3 (1.4 %). Over-triage was most common in case #2 (30.4 %) and least common in case #3 (0 %).

STUDY II

The training set included 657,918 visits to the EDs and 17,339,331 visits to the Internet health care guide 1177/Vårdguiden web-site. The validation set included 146,975 visits to the EDs and 3,440,668 visits to the web-site. Seasonal (monthly) as well as weekly and hourly variation in both flows were seen and the statistical significance in the variation was verified. Christmas Eve, New Year's Eve and Midsummer Eve was the three least burdened days for both the website and the ED. The hours 11:00 am – 1:00 pm were the most burdened hours for both instances, but while inflow to the EDs decreased after 1:00 pm, the web-site visits increased again between hours 8:00 pm – 10:00 pm.

In a graphical analysis, it was deemed likely that the second increase (8:00 pm – 10:00 pm) of inflow to the web-site could predict the coming days' inflow to the ED, as the correlation between the number of website visits in the evening and ED inflow the next day was significant and exhibited a high correlation, with a correlation coefficient of 0.77 (95% confidence interval 0.72 to 0.81). The prediction accuracy of the constructed forecasting model was MAPE_{total county} 4.8 % while MAPE_{individual ED} ranged from 5.2 % - 13.1 %.

STUDY III

There was a linear increase of the inflow to the EDs to a daily increase of 26 % over the ten years included in the study.

While the ED inflow showed seasonality over day-of-the-week and months and increase over the years, sentiment in the news media headlines expressed as the aforementioned (see Section 5.3) sentiment index (HUI) did not show seasonality. However, an increasing trend of

HUI over the years was detected. But whereas ED inflow increased in a linear fashion, an annual low was seen during year 2009 for the HUI.

The HUI significantly impacted the ED inflow in all the three models (total, adult and pediatric populations) assessed in the study. The strongest impact was seen for the total population, and the weakest for the pediatric ditto. For the total and adult population the estimate of the effect of the HUI was stronger than the effect of the moving average (MA) and autoregressive (AR) components of the models. For the pediatric population, this was not true, but the effect estimate was still significant if also small.

Another sub-analysis was conducted, assessing the effect of a lagged HUI, that is the effect of yesterday's news on ED inflow. This analysis yielded no significant results. It was concluded that today's news affect ED inflow, whereas yesterday's news do not.

STUDY IV

Over 1.5 million calls were registered to the TAS during the year of the study, 2016. Out of these, 598,414 were excluded because of caller not stating or not having a personal number or the calls did not result in any advice given to the caller. Included in the analysis of advice given was 995,732 calls. An additional 136,026 calls were excluded because of other advice than ED, OOH, PC or self-care was given, rendering 860,706 calls included in the analysis of compliance.

The analysis of the advice given showed that female callers had lower odds of receiving advice of higher level of care (OR = 0.83, 95 % CI 0.82 – 0.83) while a higher age was associated with higher odds of receiving advice of higher level of care (OR = 1.08, 95 % CI 1.07-1.08). Both these demographic factors were statistically significant in the analysis. Socioeconomic status was a significant factor for the advice given, but exhibited no social gradient; low socioeconomic status was associated with advice of higher level of care (OR = 1.13, 95 % CI 1.12 – 1.14) but middle socioeconomic status had lower odds (OR = 0.89, 95 % CI 0.88 – 0.90). Socioeconomic status was statistically significant in the analysis.

The compliance rates to given advice in the calls is shown in Figure 8. The advice to seek primary care was the least complied to in all age groups except the 80+ years. The advice for self-care was the most complied advice with an average of 65 %. Depending on type of advice, demographic factors had different impact. Higher age, female sex and high socioeconomic status was associated with a higher rate of compliance.

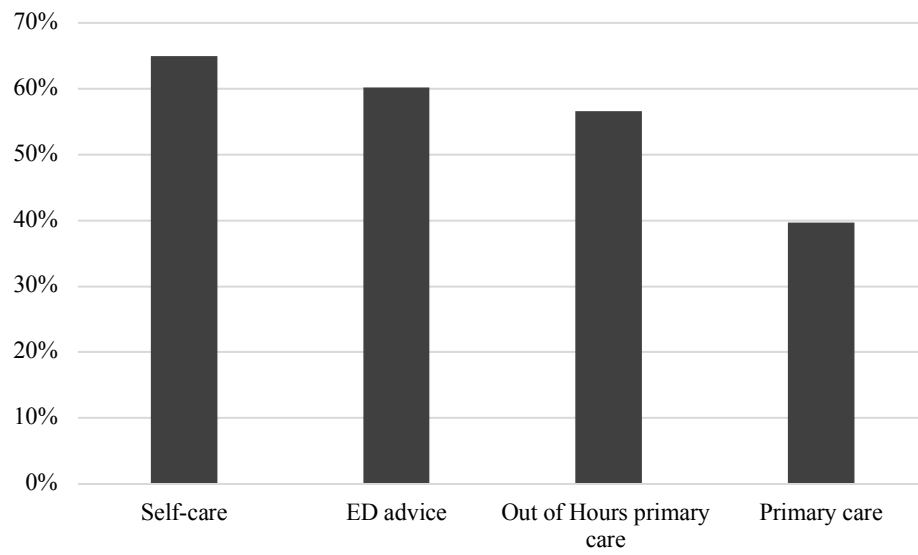


Figure 8. The compliance rates of different advice in Study IV.

7 METHODOLOGICAL CONSIDERATIONS

The methods, both in regards to study design and statistical analysis, used in the included four studies are in three cases alike each other and in one case deviant. In Study I, a prospective survey was conducted and assessed using only descriptive measures, while the Study II – IV were retrospective observational studies based on registry data. In this section, the methods and limitations of each study will be discussed. The discussion will, in a wide sense, focus on problematic aspects of the methodological choices made in each study as well as their eventual solutions or limitations to the interpretation of the results.

7.1 SETTING

The setting for Study I was a public event for Emergency Services in Stockholm City. Participants in the study were recruited among the visitors to the event. The chosen setting might skew the selection as the visitors might have had a greater interest in emergency health care than the general population. This was also evident in the assessment of the participants' previous education and experience as over 40 % had some kind of medical education, around 70 % had CPR-education and a little less than 20 % had experience of at least one accident. This constitutes a selection bias that was not corrected for, but the setting enabled swift recruitment of participants, which made the study economically viable.

The setting for Study I was also calmer than a typical site of a trauma or accident, making conclusions regarding its reliability in realistic circumstances difficult. Three (3) of the 69 participants stated that they would hesitate to use the triage instrument under real world conditions, and it is feasible to assume that the proportion of random laypersons prepared to use the instrument under real circumstances would be even less.

Study II – IV were all set in the Stockholm County and data on ED inflow was retrieved from the VAL-database (see section 5.2.2). The VAL-database is, as described above, a database of health care contacts in the Stockholm County and practically all such contacts are recorded [190, 193]. This makes the data on ED inflow almost full-population and the risk of Type II error, i.e. not getting statistical significance where such exists, should be low. The same is true for the calls to the TAS and subsequent health care contacts in Study IV.

The problem with the Stockholm County setting is that it is one county in one country. While the data sets are large (on ED inflow, on website visits, on news media sentiment and calls to the TAS) they still concern only this one county. In many ways, Sweden is a country unlike many others; the Internet-access is very high, as is the equity between socioeconomic classes and the health insurance is universal. At the same time, Swedes are very individualistic and secular-rational [194], and the studies II – IV concern societal issues such as the use of Internet health information (Study II), news headlines and the people's assessment of what is reported (Study III) and trust between the general public and public institutions (Study IV).

Furthermore, Stockholm County differs from the rest of Sweden, having the country's highest mean income and the largest urban area, although rural and socioeconomically deprived areas exist. The generalizability of the studies II – IV is therefore a concern. It would have been favorable to conduct all these three studies in more counties and/or more countries as well, even if the generalizability should not be entirely dismissed because of the setting.

7.2 METHODS

For Study I, the most concerning methodological issue was the lack of statistical power. The included participants were too few to reach power and thus statistical significance was not computed. Computing statistical significance despite having too few participants increases the risk of a Type I-error, i.e. finding statistical significance where there is none. The results of study I must be regarded as indications rather than the truths. To mitigate the methodological issues with Study I a larger population would have been needed, but as the setting described in Section 7.1 did not allow for this, the time ran out for the public event. Including participants from other settings could have been feasible.

The cases constructed for Study I were not externally validated. They were constructed and analyzed by an expert panel; the authors and colleagues. Naturally these cases affected the results of the study as a too simple or too difficult test would skew the results in an inappropriate way. An external audit of the cases, before deploying them in the study, would have been preferable.

Study II – IV were all retrospectively observational studies, and as such subjected to the risk of biases, especially the risk of confounding factors (Study II and III) and measurement bias (Study IV) [195].

For Study II, both reverse causation and confounding factors must be discussed. The risk of people attending the ED, while in the meantime visiting the 1177/Vårdguiden health information website regarding their condition, constitutes a risk of reverse causation. This would especially affect the findings of the very high correlation between same day website and ED visits. However, the differences in volume opposes this risk, with a more than a 20-fold larger volume of visits to the website than to the ED. For the eventual confounding factors, the eventuality that people use the website for information before going to the ED, it is what the forecasting is built on and as such not a risk in this particular study. There might also be a risk that the weekday influences the behavior of the population in Stockholm County, but the multivariate regression analysis showed that website visits had an impact on ED inflow regardless of the weekday. The selection of linear regression for analysis and model construction in Study II was due to the explicability of that analysis as well as its extensive use in previous studies on modelling ED inflow forecasts. For the subsequent evaluation of the model, MAPE was chosen as measure for the forecasting model's performance / accuracy. This choice was made to ensure that the results were comparable to those of previous studies. MAPE is the measure of choice when comparing models over

different datasets, as it is independent of the mean of the dataset while other error measures, e.g. MAE or RMSE, are dependent on just that and therefore not suitable for comparing different models and/or different time series [196]. The disadvantage of MAPE, however, is its sensitivity to error in the lower end of the time series and unresponsiveness to errors in the upper end, as described in Section 2.6.1. Despite this, MAPE was found to be the best choice for error measure for the scope of Study II.

Study III comprises the same risks of reverse causation and confounding factors as Study II. As Nelissen et al (2014) showed, media reporting around health and health care issues might follow the strain on health care [99], something that naturally would affect the results in Study III. To mitigate this, the sentiment index, HUI, in this study was constructed through a data driven approach and therefore encompass multiple forms of unrest or anxiety, and not only the ones concerning health and health care, lowering the risk of reverse causation.

The index itself is, however, a concern when it comes to the validity of this study. Since there was no valid index for general news media negativity or sentiment available in Swedish, it had to be constructed for this particular study.

The approach chosen was to derive the index all data driven, which means that as authors the only choice made was to choose the originating Swedish word “*orolighet*”, which translates to English “unrest” or “anxiety”. Words with similar use in the headline corpus was chosen into the index (see Appendix IV). The resulting index, the Headline Unrest Index (HUI) was not validated before the study, but approximations within the study deemed the HUI valid. Another approach would have been to choose the words of the index manually, but that would have heightened the risk of confirmation bias.

The statistical analysis method used in Study III, ARIMA, ensured that the known confounders for ED inflow was corrected for and that the effect of news media headlines on ED inflow could be independently estimated. Using “appropriate statistical techniques” on time series data is a recommended method for evaluating media impact on health outcomes, and for Study III this recommendation was followed [197].

Concerning Study IV, the most pressing risk of bias is the measurement bias. In order to measure the rate of compliance with TAS advice, the following health care contact was recorded. Compliance was noted if the call was followed by the right health care contact (or no contact for the self-care advice) within certain time frames (see Table 3).

Advice	Time frame
Emergency Department (ED)	48 hours
Out-of-hours Primary Care (OOH)	48 hours
Primary Care (PC)	5 days
Self-care	5 days

Table 3. The time frames for compliance in Study IV.

These timeframes could constitute a bias, especially for the PC advice. Stockholm County has a problem with the availability of PC and even if a patient tries to comply to the PC advice by making an appointment, it is not unlikely that the appointment will take place later than after five days. Furthermore, for the self-care advice there might be cases where the advice is appropriate at the time of the call to the TAS, but where the severity of the illness changes and health care contact is appropriate with or without a renewed TAS contact. There was within the study no way of controlling for this (see Section 7.3), but for further research into the matter, at least an estimation of the time from different advice to the first subsequent health care contact should be considered. Further assessment on why patients chose not to comply with the advice requires different research methods than was available for this study.

Interestingly, in an unpublished pilot study conducted at one hospital in Stockholm County, patients in the ED were asked if they had contacted the TAS before their arrival at the ED. Approximately 70 % of those who answered ‘yes’ to this had not, according to VAL, actually contacted the TAS. This points to uncertainty, maybe because the patients know that calling the TAS before contacting the health care in other ways is the “right” thing to do.

An estimation of the callers’ socioeconomic status is routinely recorded in VAL using the Mosaic software, and that classification was then extracted by the authors of Study IV. The Mosaic software is originally designed for marketing segmentation but has been used for other purposes as well [197]. The SCC uses it for stratifying inhabitants in different socioeconomic segments, based on the individuals habiting location. The partitioning of socioeconomic background in Study IV is consequently not based on the individual’s economic situation or other sociological factors other than the patient’s address, why the results concerning this might be biased.

7.3 DATA

Using registry (secondary) data as in Study II – IV is a cost-effective way to perform research [198]. It is also effective in the sense that research/studies are easily repeated, either for

validity or for different time periods. But there are pitfalls, biases from the construction of the data source as well as from the reporting to the source are issues that have to be taken into consideration when planning the research and analyzing the results [199]. Data sources are often not externally assessed [200]. As proposed by Sorensen et al (1996) data sources, especially sources for secondary data, should be checked for [201]

- “1. Completeness of registration of individuals
2. The accuracy and degree of completeness of the registered data
3. The size of the data source
4. The registration period
5. Data accessibility, availability and cost
6. Data format
7. Possibilities of linkage with other data sources (record linkage)”

As Study II – IV were all heavily dependent on one data source, the validity and reliability of this particular data source is a concern, even after considering all the points above. In previous studies the VAL-database has been deemed valid and reliable and there has been no reason to doubt that for the studies included in this thesis [190]. To validate the VAL-database further, would the need have been obvious, it would have been possible to extract ED inflow data from every hospital’s separate ED patient administrative system and compared it to the VAL-database for validation for study II and III and by interviewing patients regarding their calls to the TAS and their subsequent health care related action for Study IV. For economical and practical reasons this was not pursued within the studies included in this thesis.

For Study III, the data source of the news media articles was not assessed by other means than the confirmation by the private company owning the database. The coverage is therefore uncertain. The selection of the included news media, (see Section 5.1), was arguably not complete to cover all news media consumed in Stockholm County during the study period. The selection is, however, complete enough to cover all major news media consumed and the newspapers and Internet-sites included have been shown to be the most relied upon in Sweden [188]. However, the penetration of the chosen news media in the population in Stockholm County was not estimated in the study, leading to some uncertainty regarding the results.

As methodological conclusions for the studies included in the thesis, it is noted that results in Study I should be regarded as hypothesis generating, and not statistically significant truths. The results are, however, a valuable base for further studies, especially as this is the first study of laypersons triaging trauma victims. There are issues that, were they considered and/or mitigated, might have increased the quality of the research, but for Study II – IV, the results are to be considered reliable.

8 DISCUSSION

The inflow of patients to the ED varies with multiple factors. In the studies included in this thesis, different factors that might influence patients' decision to visit the ED have been investigated. The chapter at hand will put the results of the individual included studies into relation with findings in previous research. Furthermore, the findings in this thesis will be put into the context of the HBM to propose a novel way of researching ED inflow. Finally, a hitherto unpublished, and thus not yet peer-reviewed study, will be presented and briefly discussed in relation to the other results of the thesis.

8.1 STUDY I - IV

STUDY I

How laymen assess their own or other people's disease/illness/injury have implications on the decision of seeking ED care. Both internal and external factors influence the choice of and if where to seek care. The aim in Study I was to research whether layperson bystanders could triage trauma cases, but it could also be an indication to how laypersons can or cannot assess degree of illness.

The literature on laypersons assessing illness is scarce. There are no studies to directly compare the results in Study I with. However, trauma triage performed on paper cases by professionals have shown rates of over-triage in 26 – 29 % and under-triage in 13 – 70 % as compared to 12.5 % and 6.3 % respectively in Study I [202]. In the ED triage setting, over- and under-triage levels of professionals have been shown to vary between 0 – 54 % and 0 – 32.8 % respectively, with a total proportion of correct triage levels in 57.7 % of the cases [203]. In another study ED patients were correctly triaged in 61 % of the cases with rates of over- and under-triage at 21 % and 18 % respectively [204]. Thus, Study I showed triage accuracy in line with, and even somewhat better than, previous findings, although previous studies assessed the triage accuracy of professionals.

In Study I, female and younger participants triaged the cases more correctly. This is concordant with the findings of Brinkrolf et al (2017) who showed that older laypersons were less prone to engage in CPR than younger ones. Furthermore, Piepho et al (2011) showed that younger laypersons performed CPR better than older in a test situation [205]. The reason for this is not known, and is most probably difficult to explain. Göransson et al (2006) researched the inter-personal differences in nurses triaging paper-cases for an ED setting, and found that differences in triage accuracy often were dependent on intra-personal reasons, suggesting that personal decision-making strategies might be involved. Whether or not women have different decision-making strategies than men is not known [206].

As described in the background (see Section 2.5) there is one example of a pediatric triage

instrument for influenza-like illness, where patients triage themselves before seeking ED care [111]. The specificity of this instrument was shown to be 93 %, which might be attributed to the parents' correct assessment of their children's illness, but also to the reliability and validity of the triage instrument itself. This questions to whether laypersons can assess illness using an instrument, or if it is the instrument itself that is just good enough, is applicable to Study I as well.

It seems that the triage abilities of laypersons in Study I is in line those of professionals. This might of course be a methodological artifact, but the findings suggest that laypersons may be able to assess acuity of illness well. For the ED setting, one may deduce that patients are probably, in many cases, able to assess their own illness and what level of care to seek at. Therefore, more responsibility may be put onto the patients in regards to choosing the right level of care for their complaints.

STUDY II

Understanding ED inflow is an integral part of understanding ED variability and the challenges facing ED management. Forecasting models is a key to this understanding, both in developing the models and in using them.

In Study II the most influential background variable was day of the week, which is consistent with previous findings [112, 113, 117].

In an American study, the largest inflow was seen on Sundays, as opposed to the studies at hand who show a peak in inflow on Mondays [115]. In Brazil, the same weekly pattern as in Sweden seem to be present [121], as well as in Denmark [35]. In most western countries, the weekends end with Sunday, making Monday the busiest day. The same pattern is evident after other holidays, and also included in some forecasting models [39, 112, 113, 117]. In Study II the three least busy days were Midsummers Eve, Christmas Eve and New Years' Eve. This is consistent with earlier findings, including in non-western cultural settings such as Saudi Arabia, where the time of Ramadan produced different inflow patterns than other time periods without celebration [207]. The reason for the lower ED inflow on weekends and holidays is not known. It is possible that the higher social support from friends and family that may be accessible during these days result in lower levels of anxiety in the potential patient. It might also be possible that the higher degree of social responsibility, e.g. taking care of children who are otherwise in day care, makes avoidable ED visits impossible. The observed compensatory increase of ED inflow on Mondays and after holidays may point in the latter direction. Further research into the matter would be beneficial for the understanding of patients' ED visit decision-making.

ARIMA models seem to have better accuracy than naïve models for predicting the coming hour of ED inflow, but the accuracy is still modest with MAPE 47 - 58 % over four different EDs in Denmark [208].

For daily ED inflow forecasting, ARIMA models produce MAPE 4.8 – 16.2 % depending on triage level and MAPE 7.4 – 11.7 % in different settings [36, 39, 118]. Using ARIMA models for short term forecasting (daily inflow) showed a robustness against epidemic surges [209]. In spite of this, the decision to use linear regression for modelling the forecasting model in Study II seems viable when taking into account that the effect of adding Internet produced dynamic data to the model should be as explicable as possible. The results in Study II (MAPE 4.8 % for the whole region, 5.2 – 13.1 % for individual hospitals) were also comparable with the studies mentioned above, and to some extent a proportion better.

In Study II, data generated from visitor behavior to a health website was used as an independent / explanatory variable. The impact of this on the model's accuracy is not fully gauged but the impact of this variable on the model was small, but significant. The correlation between the same day number of website visits the evening before and ED visits the next day was Pearson's R 0.77, a high number. This could partially be explained by the weekday variation, which seem to steer health related interest, both expressed as web site visits as ED ditto.

As indicated in Study II, dynamic explanatory variables provide a significant addition to forecasting models. What dynamic variables to choose is not sufficiently researched. Data generated on the Internet has been shown to be explanatory in many other settings [130, 210-212], but for forecasting ED inflow of all sorts of patients the only study in this matter to date is Study II. Some pointers could be taken from McCarthy et al and Scott et al (both 2017) who, in their studies on the use of Internet for health-related information in relation to ED visits, showed that online searches for health information was conducted in about 25 % of the cases. The timeframe between the searches and subsequent ED visits were not assessed. This would be of high interest to further investigate, since these searches could constitute an important explanatory variable for future forecasting models.

It seems that the data in Study II was consistent with other studies on inflow pattern and the forecasting model produced somewhat better results, using less advanced methods. This could perhaps be contributed to the use of Internet data.

STUDY III

News media impact over health care-seeking is a scarcely studied phenomenon. There are, however, some indications that different types of health-aimed media bits have an impact on care-seeking behavior [89, 93]. The impact of general news media sentiment on a person's or a population's propensity to seek health care in the ED has not been assessed until now.

In Study III, a dataset on Stockholm County's daily ED inflow over ten years (2006 - 2015) was gathered. The daily value of an index for news media headline sentiment was recorded for the same time period.

The ED inflow data was congruent to other datasets of ED inflow over time [35, 112, 121, 214] and was therefore deemed valid.

For the index-variation over time, no equivalent or corresponding timeline has been found to compare index with. The theoretical basis for the validity of the index is, though, that the constructs of the index were mathematically computed to resemble the word “orolighet”, English “unrest” or “anxiety”. The HUI therefore consists of words with similar use the basis “orolighet”. That the index had such an impact on ED inflow could be explained from previous findings by Kim et al (2018), who showed that financial worries affect the health of adolescents in afflicted families. Faessler et al (2016) found that anxiety is a common co-factor for seeking ED care [217, 218]. As the world exhibits a more unsafe state, it is conceivable that anxiety in the population increases correspondingly, and as an effect of that, ED inflow increases as well.

While no equivalent previous studies exist to compare to the findings in Study III, there are other studies, assessing similar phenomena, e.g. previous studies that have shown that media coverage impacts how people tend to seek health care, both as campaigns focused on specific conditions and as news media reports on specific issues [89-91, 95-98].

The effect of news media headlines, HUI, was significant for the whole population as well as in the sub-analyses of adult and pediatric patients. The effect of HUI was less on the pediatric than on the adult population and the explanation for that is not obvious. Previous findings suggest that the pediatric ED population is more susceptible to surrounding anxiety than the adult ditto, but this could not be established in this current study [96, 213].

The impact of media campaigns concerning health care on ED care-seeking decision is supported by previous findings. However, the effect of news media’s regular reporting has to date not been studied to any large extent, although there are indications that media reports on health issues affect peoples’ health care-seeking behavior [197]. To what extent campaigns affect this behavior is not clear, although there seem to be some impact [219]. In Study III, the model of ED inflow was significantly impacted by news media reporting. The result appears feasible, as previous findings support the idea that the surrounding world and news media reports influence a person’s perception of health as well as health related behavior [85, 220]. One problematic aspect of investigating medias role in ED inflow is whether reports precede or follow health care related events, and the possible autocorrelation. Nelissen et al (2014) found that media reports on an influenza outbreak followed ED inflow surges of these types of patients, while Codish et al (2014) found that ED surges followed media reports [96, 99].

There seems to be a correlation between a news media headline sentiment index and ED inflow over time. In order to increase the value of such an index, its constructs should be carefully researched in order to increase the validity and reliability of the study.

STUDY IV

Study IV is one of the largest studies on TAS advice and compliance to date, with > 900 000 calls included.

More females than men use the service, in Study IV, as in previous studies. Furthermore, the distribution of TAS use over the ages was congruent to previous work [142, 148, 150]. The advice given within Study IV was dependent on the callers' sociodemographic belonging; females received self-care advice more often than men and overall women tended to receive advice for lower levels of care than men. Increasing age was a predictor of higher level of advice, as was lower socioeconomic status.

In this study, the callers' access to PC was not assessed, but McAteer et al (2016) indicated that "OK access", as opposed to "Good access" and "Poor access", increased the propensity to use TAS. The reason for this is not known, but it is possible good access prevents the use of TAS thru health issues being taken care of in the PC, while poor access may be correlated to other known causes of lower TAS use, such as socioeconomic background, health literacy et cetera.

Advice given

The self-care advice was the most common advice in the youngest age group (27.9 %), which may be an effect of concerned parents not feeling secure in how to assess their children's illness. It has previously been shown that having children increases the odds ratio of using the TAS and that 19 % of the calls is a parent calling about their child [142]. Our findings support this.

In Study IV, age, sex and socioeconomic status significantly affected the advice given, but to a relatively small extent. In studies conducted in countries with different economic systems the socioeconomic gradient is more pronounced and has a different direction than in Study IV. If the economic system is the reason, or if the reason for the discrepancy is another, cannot be explained in the scope of Study IV [142, 149, 150].

Compliance to advice

Compliance with the TAS advice decreased with increasing age, while the compliance to the ED advice specifically increased with age. The overall compliance in Study IV was lower than in another comparable Swedish study, where overall compliance was 81 %. The compliance rates for the different advice were also significantly higher, for example, compliance to ED advice was 100 % [214]. This might be an effect of the method used in this study, where patients were asked to participate and whether they had complied to the advice or not. The Hawthorne effect on results cannot be ruled out [215]. In Study IV, all calls to the TAS in Stockholm County during a year were included, and compliance was computed by following up patients' health care contacts subsequent to the TAS call in a pre-existing database. The findings of overall compliance to TAS advice in Study IV were congruent with other previous studies [140, 151-154, 214].

Socioeconomic background affected compliance, where the two lower groups (out of three) had lower compliance rates than the highest. For the ED advice specifically, this was true as well. The reason for this is not known, but there are indications in previous studies. Trust in

the service is important for compliance, as a low level of trust may result in low levels of compliance [151]. However, low trust in the health care system is not obviously linked to low socioeconomic status, as shown by Meyer et al (2012), where medical advice was more often questioned by patients belonging in the higher socioeconomic groups [54].

The high rates of compliance seen for women compared to men, a pattern found in previous studies as well, might be an effect of women calling more often and more often receiving the self-care advice, which is the advice most adhered to [148]. The higher use of the TAS for women contra men, might be a sign of higher trust in the TAS, which, as described above, would also lead to a higher level of compliance. This, though, was not proven within the realms of Study IV.

It seems that sociodemographic factors influence both the advice given by the TAS as well as the compliance to said advice. The cause for this is not explained, but the knowledge may be used to further assess and work on increasing the equity of health care access for all groups.

8.2 THE HBM AND ED CARE-SEEKING

In this section, the results of Study I – IV will be discussed in relation to HBM and possible implications. Furthermore, ideas for future research will be presented.

Studying ED inflow through the application of HBM could, arguably, be a way of understanding the individual patients' as well as a populations propensity to seek ED care [216], thus increasing the chance of creating a better understanding of the ED inflow variability making construction of more accurate forecasting models possible.

The thesis at hand shows, through the four included studies, that the decision to seek health care in the ED is not only dependent on the individual's perception of the severity of the illness, but that other factors influence this decision as well. Against this backdrop, and the previous research presented in Chapter 2 above, is it viable to apply HBM on the decision to seek ED care and its' impact on ED inflow.

All four included studies concern either cues to action or modifying factors for ED visits in the sense of HBM, and the results may be used for hypotheses generating purposes in further research into using HBM as a model of explanation for ED visits or ED inflow. The main results to use for further research is:

1. The ability for laypersons to assess their own and others level of illness/acute which modifies the propensity to seek ED care.

Study I researched the feasibility of letting laypersons value the severity of illness of three physically traumatized persons. The results indicated that correct assessment were made to a certain degree (52 %) and that the correctness of the assessment was partially correlated with background factors such as age. How a person assess his or her own illness or disease is lesser known (see Section 2.5). It could be conceived that

sociodemographic factors modify how a person perceives an illness in herself. Thus, the perceived threat and perceived benefit of seeking the ED for that threat may vary from person to person. However, some sociodemographic factors will act as modifiers, although Study I indicates that approximately half of the population may perceive levels of illness as it should be perceived. When computing a person's propensity to seek the ED for care, such modifiers must be taken into consideration. Further research should focus on estimating the effect of background factors on the self-assessed severity of illness, estimating both the HBM constructs *percieved threat* and *modifying variables* and their mutual impact.

2. The modifying impact of online health information (OHI) and the meta-information that can be drawn from the searches of it.

In Study II, the correlation between visits to a health care website and physical ED visits were assessed and a forecasting model was constructed through the findings of this correlation. OHI impacts health behavior as shown by, among others, Khoo et al (2008) and Scott et al (2017) [76, 78] and may therefore be seen as modifying factors or cues to action in a HBM sense. Socioeconomic background affects the consumption of health media as well as health behavior [84]. Estimating the effect of OHI as a modifier for ED visits must therefore be made with regards to socioeconomic background. Further research should further assess the impact of OHI on the ED care-seeking decision, as OHI can be viewed as a *modifying variable* and effects on both the HBM constructs *percieved threat* and *perceived barriers* is conceivable.

In Study II, the forecasting model utilized the most well-known factor affecting ED inflow; day of the week. This is supporting the findings of Hertzum et al (2016), who also showed that hour of the day, month of the year and holidays are factors affecting ED inflow and as such they should be regarded as HBM modifiers [35]. Further studies on the relation between time variables and patient background factors would be valuable, as two *modifying variables* mutually effecting eachother.

3. Unrest in the surrounding world as a modifier of ED care-seeking behavior.

In Study III, it was shown that news media headlines sentiment, regardless of subject, modified the ED inflow in a region. The suggested mechanism through which this effect occur, is through a person's (or a population's gathered) level of anxiety. As Faessler et al (2016) showed, the patients' psychological distress is a co-factor in the ED and the psychological impact of secondary exposure to trauma (through, for example, media consumption) has been well-studied [215, 218]. It has also been shown that events less traumatic than violent terrorist attacks affect the anxiety levels [217]. It is feasible to conclude that an increased level of anxiety within a person increases the propensity for that particular person to seek care at the ED and that negative media reports may affect ED care-seeking behavior through this pathway.

However, what constructs of HBM this effect is mediated by, or if the modifier is independent is not known.

Future research should further study the impact of news media reporting, as a modifying variable of ED inflow, especially with better methods than the negativity index of Study III.

4. TAS advice as cue to action and sociodemographic factors as modifying factors, cues to action, perceived threat, perceived barriers and self-efficacy.

In the case of the TAS advice as cues to action, it has been shown that instructions or recommendations from care providers have effect on health behavior [168-170] and it is reasonable to believe that TAS advice have a similar effect. The difference in effects between a known health care provider, such as a GP, and the TAS, would be the probable higher level of trust in the former, making a cue to action from the GP stronger on the subsequent decision [54]. However, as was pointed out in two Swedish studies, the calls to the TAS changed the caller's previous decision on what level of health care to seek at. The TAS advice was shown to both lower and increase the actual level where care was sought, indicating that the TAS advice had an impact, both as cues to action and as modifier of the antecedent decision [70, 214].

As for the TAS as a modifier, there are previous findings that speak for a modifying effect on the construct *self-efficacy*. Gustafsson et al (2017) showed that reassurance of an illness being minor or self-terminating increased propensity for self-care [217]. Reassurance could thus increase the sense of self-efficacy. It is also feasible to believe that this modifying effect also affects the perceived threat that the caller is experiencing and that the TAS as a guide in the range of health care providers also might modify the perceived barrier construct.

The modifying effect of sociodemographic factors on the callers' compliance to advice was also shown in Study IV. It is possible to draw the conclusion that sociodemographic factors also affect the decision to seek care at the ED, however this has not been studied in the scope of Study IV although it has been reported in previous studies [29, 47]. Future research should aim at clarifying the sociodemographic background of patients as *modifying variables*.

In summary, Study I – IV shows that a large range of factors may be regarded as cues to action and modifiers of the ED care-seeking decision within a person as well as the propensity for ED care-seeking within a population. This perception is further strengthened by findings in an unpublished study, see Section 8.3. It should be possible to estimate the effect of all the HBM constructs on ED care-seeking decision-making, and apply those estimates to the population as a whole. With this suggestion, better models for understanding and forecasting the ED inflow within a region or to an individual hospital could be constructed, making emergency department care more predictable as a step towards improving the quality of health care services. However, further research is needed in order to

fully address the issue. Researching the ED care-seeking decision in the HBM perspective, clarifying the contents of the HBM constructs and estimating the relationship between them would be of great value for further understanding of ED inflow.

8.3 THE EASTER TERRORISM INCIDENT AND ED INFLOW

During year 2017, another study was conducted, outside the scope of the thesis at hand. While the results from this study distinctly strengthens the conclusions in the thesis, a brief summary of the study and its results will be included here and discussed.

The study is a retrospective observational study, in which aggregated data on ED inflow (number of ED patients / day) for all seven EDs in the county was analyzed in regards to changes in inflow during the days and weeks following a terrorist attack in Stockholm, Friday April 7, 2017, the Friday before Easter week [218].

Data on ED visits for January 1 2013 to May 31 2017 was gathered from Stockholm County Council VAL-database (see Section 5.2), and aggregated to numbers of ED visits for each of the included days. No personal data was gathered.

To analyze the effect of the terrorist attack on ED inflow, the Difference-in-Difference (DiD) estimator was used, where the ED inflow to the included EDs during the years before the attack was used as control group and the time after the attack as the intervention group. The DiD-technique is often used to assess effect on outcome variables in observational studies [219-221]. The DiD estimates the effect of the intervention by comparing the mean change in the outcome variable (ED inflow) between the intervention and the control group. Under the assumption that the outcome in the control- and intervention groups would vary as parallels without an intervention, the DiD-technique produces an unaffected causal estimate of the effect of the intervention on the outcome.

The result of this study shows a statistically, and clinically, significant decreased inflow of patients to the EDs in Stockholm County the weeks following a terrorist attack. In mean, the ED inflow decreased with 8 % daily during more than two weeks after the attack (see Figure 9). As far as it could be judged, this is the first study on how the inflow to non-psychiatric EDs is affected during the days and weeks after a nearby terrorist attack, even though mental health and general well-being have been shown to decrease even after indirect exposure to terrorism [220].

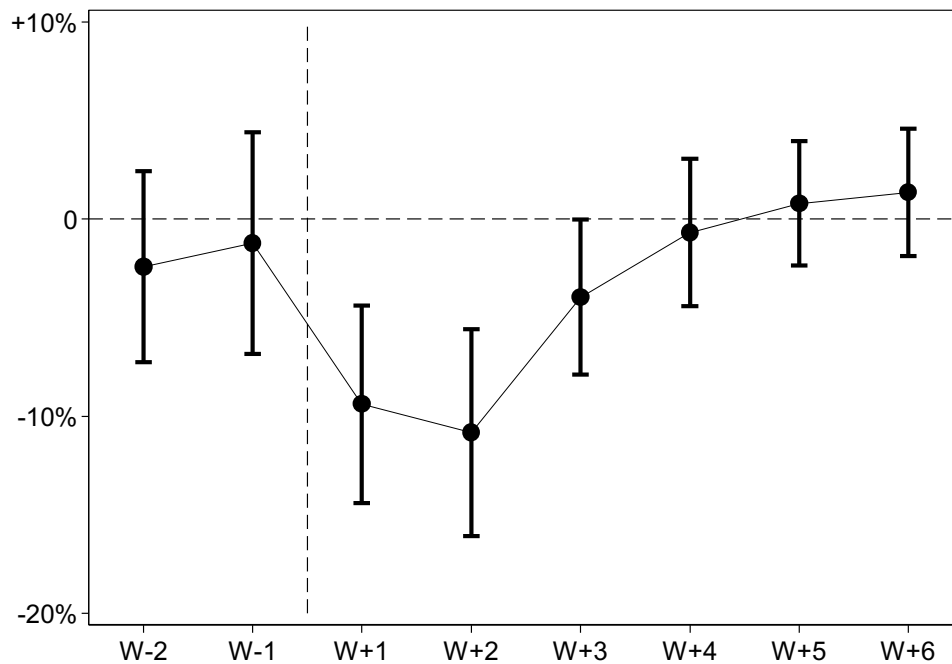


Figure 9. The estimated impact of the terrorist attack on ED inflow (y-axis) over time (x-axis). Error bars 95% CI. The graph shows that no effect occurred prior to the attack which confirms the parallel trends assumption. Note the increase to normal levels in week 3 and forward, without obvious rebound effect [218]. W = week. Dotted vertical line = W0, week of the terrorist attack.

In addition to the findings in Study I – IV, supporting results were seen in this unpublished study where a terrorist attack lead to decreased ED inflow for as long as three weeks after the attack. The study does not propose an explanation for this, but it may be hypothesized that ED care-seeking behavior was modified through either increased levels of anxiety (acting as a modifier of multiple HBM constructs) or that the terrorist threat overshadowed the perceived threat of an eventual illness. Further research is needed to clarify the mechanisms through which the ED care-seeking behavior is altered by such events. Still, it seems that a terrorist attack, with a limited outcome on the number of physically harmed or killed, affects the inflow to nearby EDs for weeks after the event. The findings are concordant with the results from Studies III-IV and strengthens the hypothesis that external modifying factors impacts the ED care-seeking behavior.

9 CONCLUSIONS

The aim of this thesis was to explore different modifying factors of ED inflow.

The thesis shows that the choice to go to the ED is modified by, online health information, news media reporting, advices from the TAS and by the individuals' own sociodemographic background.

Factors influencing and modulating an individuals' decisions to seek health care at the ED are diverse but can be explored. This thesis suggests further research into the matter is based on HBM as a framework.

In Study I, it was indicated that laypersons are capable of triaging trauma victims as expressed as paper cases. With this finding, it is feasible to believe that laypersons might assist in adverse events with high numbers of casualties, especially when these events occur in localizations where emergency resources are scarce. It is also concluded, from the findings in Study I, that there are indications towards laypersons to a certain extent are able to assess severity of illness in a wider sense and therefore is to be regarded as a HBM modifying variable or the perceived threat of the potential patient's decision to seek ED care.

In Study II, it is concluded that using Internet-data mirroring the population's use of a regional health-care information web-site, as explanatory variable, increased the accuracy of a ED inflow forecasting model. Data generated online, either by the user themselves ('user generated content'), or metadata on specific Internet use, could be estimated and incorporated in forecast-modelling. It is also concluded that, as OHI is increasingly important for potential ED visitors, more attention should be given to OHI as a HBM modifying variable of the decision to seek the ED or not.

In Study III, it was found that news media headlines mirroring the surrounding world impact ED inflow. It is concluded that the decision to seek ED care is not dependent on medical necessity alone. The state of the surrounding world should be regarded as a HBM modifying variable of ED inflow.

In Study IV, it is concluded that sociodemographic background of the caller affects the advice given from a TAS the compliance to this advice. It is also concluded that the advice itself affect the compliance. Sociodemographic background should be regarded as a HBM modifier of the decision to seek ED care, especially when the decision has been already affected by advice from a TAS. The advice from the TAS may be regarded as a HBM cue to action or a modifying variable of the patients' ED care-seeking.

Applying HBM to ED inflow research could help understanding the processes through which the patients' illness, background and other modifying factors interact.

10 IMPLICATIONS

- For future trauma and mass-causality situations laypersons may be able to help to a larger extent than today, using easily dispersed triage instructions.
- Forecasting models for ED inflow should include other types of variables than those historically used, especially Internet data can be useful to predict the inflow better than today.
- Forecasting models for ED inflow should also include the modifying impact of non-health related factors, such as news media reporting on societal events.
- The TAS need to build trust with the person calling in, in order to ensure compliance to the advice given.
- Equity in the TAS service needs to be further assessed and inequity counteracted
- The ED care-seeking decision should be research using HBM, the contents of the HBM constructs and the relationship between them estimated.
- When planning for regional or national interventions to steer patients to the most appropriate level of care, effects of modifiers of health behavior must be taken into considerations

11 SUMMARY IN SWEDISH

Inflödet av patienter på akutmottagningar ('akuten') ökar i stora delar av världen. Dessutom minskar antalet akutmottagningar, också det i stora delar av världen, inklusive i Sverige. Från år 2004 till idag har antalet akutmottagningar minskat från 79 till 58 och antalet sängplatser på svenska sjukhus minskar också.

Överbelastning på akutmottagningen (på engelska: *overcrowding*) är inte endast ett problem för personalen på akutmottagningen utan också för patienterna som söker vård där. Tidigare forskning har visat att överbelastning på akutmottagningar leder till sämre vård och ökad dödlighet bland de patienter som vistas på akutmottagningen när överbelastning inträffar.

Inflödet av patienter på akutmottagningarna är mycket varierande. Variationen kan till stor del förklaras med att människor väljer att söka akutmottagningarna i olika utsträckning beroende på tid på dygnet, dag i veckan och beroende av andra faktorer, även oväntade saker så som sportevenemang på TV gör att inflödet på akutmottagningen minskar för en stund.

Health Belief Model ('hälso-uppfattningsmodellen', HBM) är en modell med vilken man kan undersöka hur olika faktorer samspelar när människor tar beslut kring sin hälsa. De faktorer som ingår i modellen är 1. Uppfattat hot (av den hälsofara man vill undersöka) 2. Uppfattad vinst (av att göra något för sin hälsa) 3. Uppfattade hinder (mot att genomföra de åtgärder som behövs för att minska faran) 4. Egen förmåga (för att hantera faran och genomföra de åtgärder som behövs) 5. Anmodan till åtgärd 6. Andra påverkande faktorer (modifierande faktorer). HBM har använts för att förklara hälsobeteende inom många olika områden, men aldrig för att förklara människors beslut att söka vård på en akutmottagning. I avhandlingen förs det fram att det vore bra att undersöka om det går att använda HBM på det sättet. Det kan vara ett sätt att lära sig att bättre förstå variationerna i akutmottagningens inflöde.

Att förstå akutmottagningsinflödets variationer så bra som möjligt gör att åtgärder kan riktas mot att hantera dessa variationer och på så sätt minska risken för att akutmottagningen blir överbelastad.

Syftet med avhandlingen var att undersöka faktorer som påverkar antingen en människas beslut att söka en akutmottagning för vård och därmed kan påverka inflödet av patienter till akutmottagningen.

Fyra studier genomfördes och inkluderades i avhandlingen, och dessa beskrivs nedan.

I Studie I undersöktes lekmäns förmåga att bedöma allvarlighetsgraden av en skadad person. De deltagande lekmännen fick tre fall presenterade för sig, i form av text på papper som beskrev patienter som varit med i en bilolycka, och en beskrivning i hur patienter kan bedömas. Det visade sig att unga personer och kvinnor var bättre på att bedöma allvarlighetsgraden än män och äldre, men resultaten var inte helt tillförlitliga på grund av att

deltagarantalet var litet. Resultaten får därför ses som indikationer och inte sanningar. Studiens bidrag till avhandlingen var att det ändå verkar som att lekmän kan bedöma allvarlighetsgrad av sjukdom eller skada och att personer som funderar på att söka vård på en akutmottagning troligen kan bedöma om just akutmottagningen är rätt vårdnivå.

I Studie II undersöktes om det med hjälp av data avseende söktrycket på 1177/Vårdguidens hemsida på Internet (en hemsida som vid tidpunkten för undersökningen endast riktade sig mot invånarna i Stockholms län) kunde förutse morgondagens inflöde på akutmottagningarna i Stockholm. Det visade sig finnas en stor samstämmighet mellan söktrycket på hemsidan och det faktiska inflödet på akutmottagningarna dagen efter. När sedan en matematisk modell för att förutsäga inflödet på akutmottagningarna konstruerades med hjälp av denna nya vetenskap, visade det sig att modellen var bättre på att förutsäga nästa dags inflöde än de flesta andra sådana modeller, som tidigare hade beskrivits i vetenskaplig litteratur. Modellens felmarginal var 4,8 %. Studiens bidrag till avhandlingen var att det finns samstämmighet mellan hur människor i en region söker efter hälso- och sjukvårdsinformation och hur människorna i samma region sedan söker akutsjukvård. Hälso- och sjukvårdsinformation kan ses som en modifierande faktor för beslutet att söka akutsjukvård.

I Studie III undersöktes huruvida nyhetsmedias rapportering om omvärlden i stort påverkade inflödet på akutmottagningarna i Stockholms län. Ett index av olika ord som speglar oro konstruerades antalet sådana ord i nyhetsrubriker i de stora nyhetsmedia i Sverige undersöktes för varje dag mellan 2006 och 2015. Varje dag fick på så sätt ett värde som angav hur negativ nyhetsrapporteringen varit den dagen. Samtidigt undersöktes inflödet av patienter på akutmottagningarna i Stockholms län dag för dag under samma tidsperiod. Därefter undersöktes hur stor påverkan negativitet i media hade på inflödet av patienter på akutmottagningarna. Det visade sig att nyheternas negativitet påverkade patientinflödet på så sätt att ju mer negativt omvärlden skildrades desto fler patienter kom till akutmottagningarna. Studiens bidrag till avhandlingen var att den visar att även omvärldsläget påverkar akutmottagningsinflödet och därför bör ses som en modifierande faktor.

I Studie IV undersöktes alla telefonsamtal till 1177, i Stockholm under år 2016 för att det skulle kunna bedömas om inringarens bakgrund (kön, ålder och socioekonomi) spelade någon roll i vilket råd han eller hon fick, och om det spelade någon roll i hur inringaren valde att följa rådet. Sammanlagt 995 732 samtal till 1177 var med i studien vilket gör den till en av de största studierna i sitt slag i världen. Det visade sig att män och de personer som kom från lägre socioekonomiska bakgrund i högre utsträckning fick råd om att söka akutmottagningen än andra. Det visade sig också att kvinnor och de från högre socioekonomisk bakgrund följde råden i större utsträckning än andra. Studiens bidrag till avhandlingen var att människors bakgrundsfaktorer såsom ålder, kön och socioekonomisk bakgrund påverkar (modifierar) både vilka råd en telefonrådgivning ger men också hur dessa råd följs. Dessutom kan telefonrådgivningen ses som en faktor som ger inringaren vägledning till att göra vad som behöver göras för att öka chanserna till god hälsa i ett akutsjukvårdsperspektiv.

Sammanfattningsvis visar avhandlingen att flera olika faktorer kan påverka människors beslut att söka vård på akutmottagning och därmed akutmottagningars inflöde och att dessa faktorer går att finna och också att det är möjligt att avgöra hur stor påverkan de har på inflödet. Ytterligare en studie, som genomfördes efter att avhandlingens studier var klara visade på att akutmottagningsinflödet sjönk kraftigt under tre veckor efter en terroristattack i Stockholms innerstad. Detta resultat stärker avhandlingens slutsats.

Genom att använda sig av HBM bör modifierande faktorerers påverkan på beslutet att söka akutsjukvård, och genom det akutmottagningarnas inflöde, lättare kunna utvärderas och värderas i förhållande till andra faktorer hos den enskilda människan. Det är viktigt att ta de modifierande faktorernas påverkan på patienter i beaktande i de fall när styrning av patienter till rätt vårdnivå skall planeras.

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14 APPENDICES

14.1 APPENDIX I



BESKRIVNING AV OLYCKA OCH FALL

Du kommer som första person till en plats på motorvägen (fartgräns 110km/timme) där två personbilar just har frontalkrockat. Båda bilarna är väldigt förstörda av krocken, motorhuvorna är nästan helt intryckta. Vid den ena bilen ser du två personer och i den andra bilen sitter en person kvar. Du ringer 112 och berättar vad du ser.

Larmoperatören ber dig stanna kvar och försöka ge honom en bild av hur skadade personerna. Du får en kort instruktion och till din telefon skickas en bedömningsmall.

Fall 1

Bredvid bil 1, på passagerarsidan, ligger en man som är cirka 40 år. Han har blod runt munnen, håller händerna på magen och andas snabbt. Han ligger med slutna ögon men tittar på dig när du pratar med honom. Du mäter pulsen till 108 slag/minut och andningstakten till 28 andetag/minut. När du frågar hur han mår säger han att han har ont i magen. Han svarar redigt på dina frågor. Med tanke på hur ont han verkar ha i magen lyfter du lite på hans tröja o ser ett stort blåmärke som löper diagonalt över hela magen.

Fall 2

På andra sidan bil 1, förarsidan, står en kvinna som också verkar vara runt 40 år gammal. Hon gråter och skriker att hon har ont, du ser att hennes vänstra arm ser sned ut, du ser att en del av skelettet sticker ut genom tröjan och det droppar blod från vänstra handen. Hon försöker hela tiden få din uppmärksamhet och är förstås väldigt rädd. Du säger att du måste mäta hennes puls och tar tag i hennes friska högra handled och mäter så pulsen till 90 slag/minut, samtidigt passar du på att mäta andningstakten. Den är 17 andetag/minut. Kvinnan är helt vaken.

Fall 3

I bil 2, på förarsätet, sitter en man. Han svarar inte när du försöker prata med honom och han hänger med huvudet. Du hör att det piper i hans luftrör varje gång han tar ett andetag. Hans andningstakt är 7 andetag/minut. När du tar hans puls i högra handleden kan du mäta den till 80 slag/minut. Du försöker väcka honom, skakar hans hand honom så mycket du bara vågar, och nyper i huden, men han ger inget svar och tittar inte ens upp.

English translation

DESCRIPTION OF ACCIDENT AND CASES

You arrive as the first person to a site on the motorway (speed limit 110 km/hour) where two cars have just collided front-to-front. Both cars are demolished by the crash, the hoods both almost all pushed towards the center of the cars. By one of the cars you see two persons and in the other car one person is still inside. You call 112 and tell them what you see. The emergency call taker asks you to stay and try to give him an overview of the injured persons. You receive a short instruction and to your phone a triage instruction is sent.

Case 1

Beside car #1, on the passenger side, lays a man who is approximately 40 years old. He got blood around his mouth, holds his hands on his stomach and breaths fast. He has his eyes closed but looks up on you when you talk to him. You measure his pulse to 108 beats per minute and his respiratory rate to 28 breaths per minute. When you ask him how he feels, he complains over pain in his stomach. He answers readily to all your questions. As you lift his shirt, you see a bruise diagonally over his abdomen.

Case 2

On the other side of car #1, drivers' side, a woman stands. She seems to be about 40 years old as well. She is crying and screaming that she is in pain. You can see that her left arm looks crooked, there is also a bone sticking out through her shirt and blood drips from her left hand. She is constantly trying to get your attention and is of course very scared. You tell her that you will have to measure her pulse and grab her right, intact, wrist. The pulse is 90 beats per minute. At the same time you measure her respiratory rate, which is 17 breaths per minute. The woman is completely awake.

Case 3

In car #2, on the drivers' seat, is a man. He does not answer when you try to talk to him and his head is hanging. You can hear a whining noise as he breathes. His respiratory rate is 7 breaths per minute. When you measure his pulse, on his right wrist, you measure it to 80 beats per minute. You try to wake him up, shake his hand as much as you dare, pinch his skin, but he is unresponsive and does not even look up.

14.2 APPENDIX II



Sorteringsinstrument

	RÖD	ORANGE	GUL	GRÖN
Luftvägar	Väsande, pipande eller annan onormal andning	Normal andning	Normal andning	Normal andning
Andningstakt	≥ 30 /min, ≤ 8 /min	20 - 25 /min	9 – 20 /min	9 – 20 /min
Puls	≥ 130 /min	110 – 129 /min	100 – 109 /min	< 100 /min
Vakenhet (väckbarhet)	Går ej att väcka	Väcks genom omruskning eller nyp	Väcks genom att man pratar eller ropar	Helt vaken

Triage instrument

	RED	ORANGE	YELLOW	GREEN
Airways	Wheezing or otherwise not normal breathing	Normal breathing	Normal breathing	Normal breathing
Respiratory rate	≥ 30 / minute ≤ 8 / minute	20-25 / minute	9-20 / minute	9-20 / minute
Pulse	≥ 130 / minute	110-129 / minute	100-109 / minute	< 100 / minute
Responseiveness	Unresponsive	Can be awakened through shaking or pinching	Awakened through talking or shouting	Spontaneously awake

14.3 APPENDIX III



SVARSBLANKETT TRIAGE

Basdata

Kön MAN KVINNA

Ålder _____

Postnummer _____

Sjukvårdsutbildning JA NEJ

HLR-utbildad JA NEJ

Tidigare erfarenhet av
stor olycka JA NEJ

Prioritering av fall

Fall 1 RÖD ORANGE GUL GRÖN

Fall 2 RÖD ORANGE GUL GRÖN

Fall 3 RÖD ORANGE GUL GRÖN

Om uppgiften?

Upplevelse av att använda
sorteringsinstrumentet LÄTT SVÅRT

Skulle du kunna tänka dig att
använda det i verkligheten? JA NEJ

English translation



QUESTIONNAIRE TRIAGE

Background data

Sex MALE FEMALE

Age _____

Postal code _____

Health care
education YES NO

CPR-education YES NO

Prior experience of
serious accident YES NO

Prioritization of cases

Case 1 RED ORANGE YELLOW GREEN

Case 2 RED ORANGE YELLOW GREEN

Case 3 RED ORANGE YELLOW GREEN

About the task?

Experience of using the
triage instrument EASY DIFFICULT

Would you use it
in real life? YES NO

14.4 APPENDIX IV

The constructs of the Headline Unrest Index in Study III and their English translation

<i>SWEDISH WORD</i>	<i>ENGLISH TRANSLATION</i>	<i>SWEDISH WORD</i>	<i>ENGLISH TRANSLATION</i>
<i>kritisera*</i>	<i>criticize</i>	<i>jakt</i>	<i>hunt</i>
<i>svag*</i>	<i>weak</i>	<i>strid</i>	<i>battle / fight</i>
<i>mardröm*</i>	<i>nightmare</i>	<i>skott dram*</i>	<i>gunshot drama</i>
<i>chock*</i>	<i>shock</i>	<i>våldsvåg*</i>	<i>wave of violence</i>
<i>oro*</i>	<i>unrest / anxiety</i>	<i>mysterium</i>	<i>mystery</i>
<i>dödlig*</i>	<i>deadly</i>	<i>attentat*</i>	<i>attack</i>
<i>fusk*</i>	<i>cheat</i>	<i>mystisk</i>	<i>mystical</i>
<i>rasism*</i>	<i>racism</i>	<i>FBI</i>	<i>FBI</i>
<i>ned</i>	<i>down</i>	<i>massak*</i>	<i>massacre</i>
<i>kravall*</i>	<i>riot</i>	<i>pirat*</i>	<i>pirate</i>
<i>skak*</i>	<i>quake</i>	<i>utman*</i>	<i>challenge</i>
<i>protest*</i>	<i>protest</i>	<i>ras*</i>	<i>race</i>
<i>taktik*</i>	<i>tactic</i>		

* Wild-card, meaning that any pre- or post-positioning containing the construct would be counted in the index